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158

WATER RIGHTS ON INTERSTATE STREAMS:

THE PLATTE RIVER AND TRIBUTARIES.

RESULTS OF INVESTIGATION.

BY
RALPH PALMER TEELE,
Expert in Irrigation Institutions.

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WATER RIGHTS ON INTERSTATE STREAMS.

RESULTS OF INVESTIGATION.

By R. P. Teele, *Expert in Irrigation Institutions.*

THE PLATTE RIVER AND TRIBUTARIES.

The law prescribing the work to be done by this Office originally provided for the investigation of the "laws of the States and Territories as affecting irrigation and the rights of appropriators." Under this provision studies of the laws of several of the States have been made.[a] In 1903 this law was changed by adding to the above clause, "and of riparian proprietors." In response to many requests from the people interested in the control and use of water of the streams flowing east from the Rocky Mountains, a study of the laws affecting the distribution of the water of the Platte River and its tributaries was begun in 1903.

These streams present two questions which have not been extensively dealt with in former reports: (1) What is the relation between rights acquired by "appropriation" and riparian rights on the same stream? and (2) What is the relation between rights to water from the same stream in different States? Since only rights acquired by appropriation are recognized in Colorado and Wyoming, and the rights of riparian proprietors are recognized only in Nebraska, on these particular streams these questions merge into one: What are the relations of rights to water from the Platte River and its tributaries in different States? This report is a discussion of that question.

The accompanying map (Pl. I) shows that the course of the South Platte lies in the States of Colorado and Nebraska; that of the North Platte lies in Colorado, Wyoming, and Nebraska; while the main stream is in Nebraska. A study of the relations between the rights to these streams, therefore, involves the study of the laws and decisions regarding water rights in Colorado, Wyoming, and Nebraska.

[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 58, 60, 96, 100, and 124.

But physical conditions are as important as laws and decisions in determining the relation of rights to water from the same stream, and consequently rainfall, the stream flow, the diversions from the streams, and the return seepage from irrigated lands have all been studied.

The field work on which this report is based was done during the summer of 1903. Mr. W. B. Dunton made a study of the laws and decisions of the three States; Mr. C. E. Tait and Prof. O. V. P. Stout made measurements of return seepage; Mr. Frank Adams collected records of diversions and crop returns, and Mr. W. F. Bartlett collected records of stream flow. Each of these agents made a study of a particular phase of the general question in hand. It was found impracticable to publish the reports entire, but it was decided rather to bring the essential points together in this one discussion. The duty of bringing the results together and determining their bearing on the question being studied was assigned to the writer, to whom the reports of the agents named were submitted. After going over these reports, the writer spent the summer of 1904 in the field collecting such information as seemed to be needed to make the general discussion complete and getting such a personal knowledge of the field covered as is necessary to an intelligent discussion of its problems.

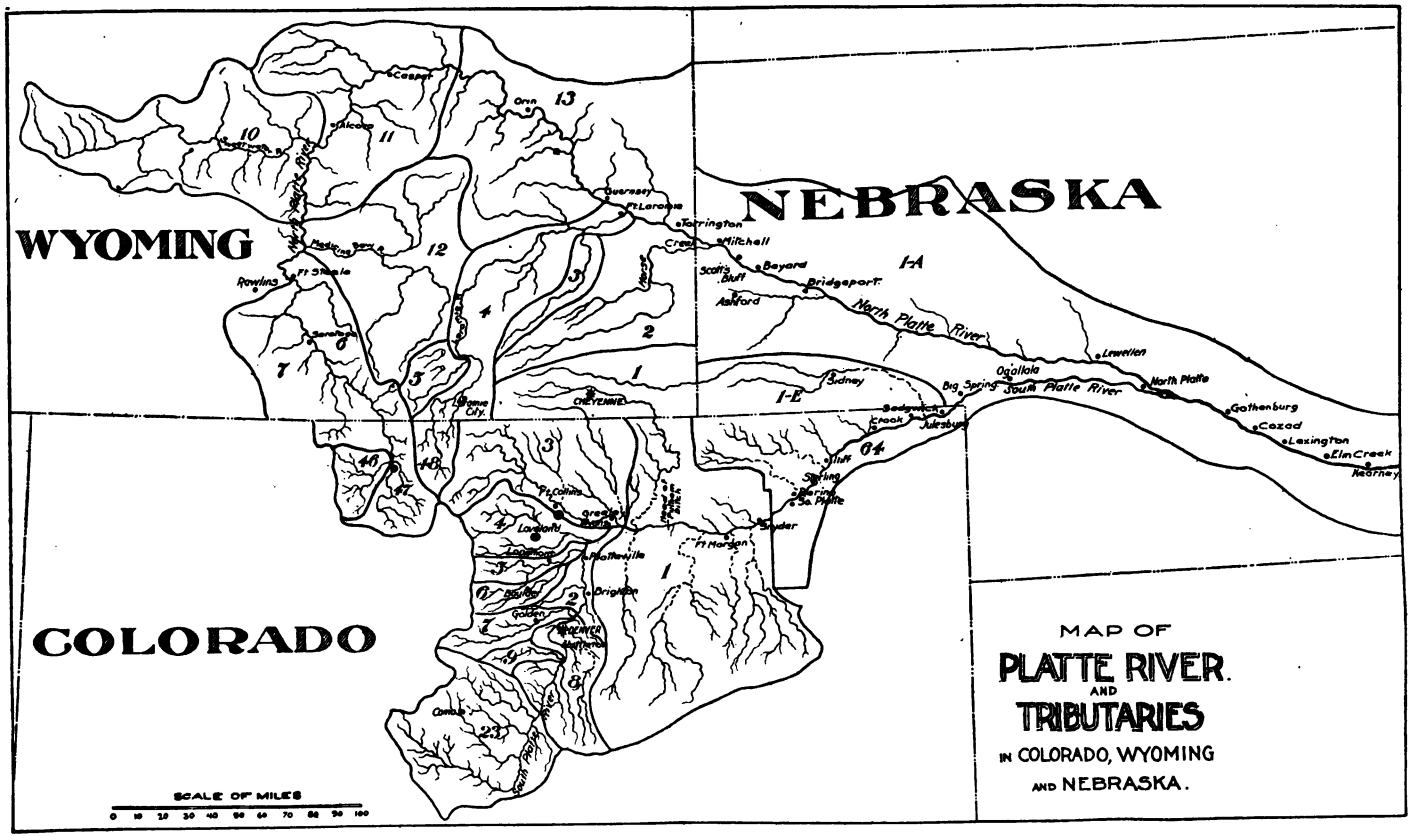
It is not possible to give in the text credit for each fact taken from these reports, and therefore general credit is given here. Most of the information regarding court decisions and rights to the streams is taken from the report of Mr. Dunton, the seepage measurements in Colorado and Wyoming are taken from the report of Mr. Tait, seepage measurements in Nebraska are taken from the report of Professor Stout, the records of diversions and of crop returns are taken from the report of Mr. Adams, and most of the records of stream discharges are supplied by Mr. Bartlett.

PRESENT CONDITIONS.

The controlling factor in the necessity for irrigation along the Platte River is the rainfall. The precipitation is heavier in the mountains, lighter on the plains at the base of the mountains, and gradually increases toward the Missouri. This is shown in the following table, which gives the normal precipitation at stations along the rivers from near the summit of the Continental Divide to the Missouri. The data are taken from the reports of the United States Weather Bureau.

PLATE I.

U. S. Dept. of Agr., Bul. 157, Office of Expt. Stations. Irrig. and Drain. Invest.



PLATTE RIVER AND TRIBUTARIES IN COLORADO, WYOMING, AND NEBRASKA.

Normal annual precipitation at stations along Platte River and tributaries.

Station.	Altitude.	Precipitation.
South Platte:	*Feet.*	*Inches.*
Longs Peak	8,600	16.47
Moraine, Colo	7,900	16.94
Cheesman	6,782	14.62
Denver	5,291	14.49
Laporte	5,069	15.29
Fort Collins	4,994	14.68
Greeley	4,637	11.92
Fort Morgan	4,000	11.74
North Platte, Nebr	2,821	18.27
North Platte:		
Saratoga, Wyo		14.08
Laramie, Wyo	7,188	9.85
Alcova, Wyo	5,450	9.44
Fort Laramie, Wyo	4,270	11.19
Gering, Nebr	3,902	15.00
Bridgeport, Nebr		16.09
North Platte, Nebr	2,821	18.27
Platte:		
Lexington	2,385	22.09
Kearney	2,147	26.89
Grand Island	1,861	28.57
Fremont	1,203	30.76
Plattsmouth	968	32.60

The facts given in the table are shown graphically in the diagrams (figs. 1 and 2). In these diagrams the horizontal scale represents distance in miles; the vertical scale represents altitude and depth of precipitation. In each curve the altitude steadily diminishes, while the precipitation is high in the extreme altitudes, drops down near the base of the mountains, then gradually increases to the east, the decrease in altitude and the increase in precipitation being remarkably uniform from the base of the mountains east. Throughout a large portion of the area the rainfall is insufficient for the needs of maximum crops.

A common assumption is that irrigation is necessary for successful agriculture where the annual rainfall is less than 20 inches. In a general way the assumption is borne out by agricultural practice along the Platte. Laporte is just at the foot of the mountains, and no agriculture is attempted without irrigation. North Platte is at the other edge of the distinctly arid zone, and there many farms are regularly irrigated except during years when the rainfall is above normal, although some are "dry farmed." At Lexington, where the rainfall is just over the 20-inch mark, a canal covers a large area of farm land, but only a part of the farmers use water, and the canal management is carrying on a campaign of education to demonstrate to the people the benefits of irrigation. At Kearney, where the rainfall is a little greater, a large canal was constructed, but is not regularly used for irrigation. Irrigation is practiced all along the North Platte, and at none of the stations on that stream does the rainfall equal 20 inches. In general, then, the distinctly

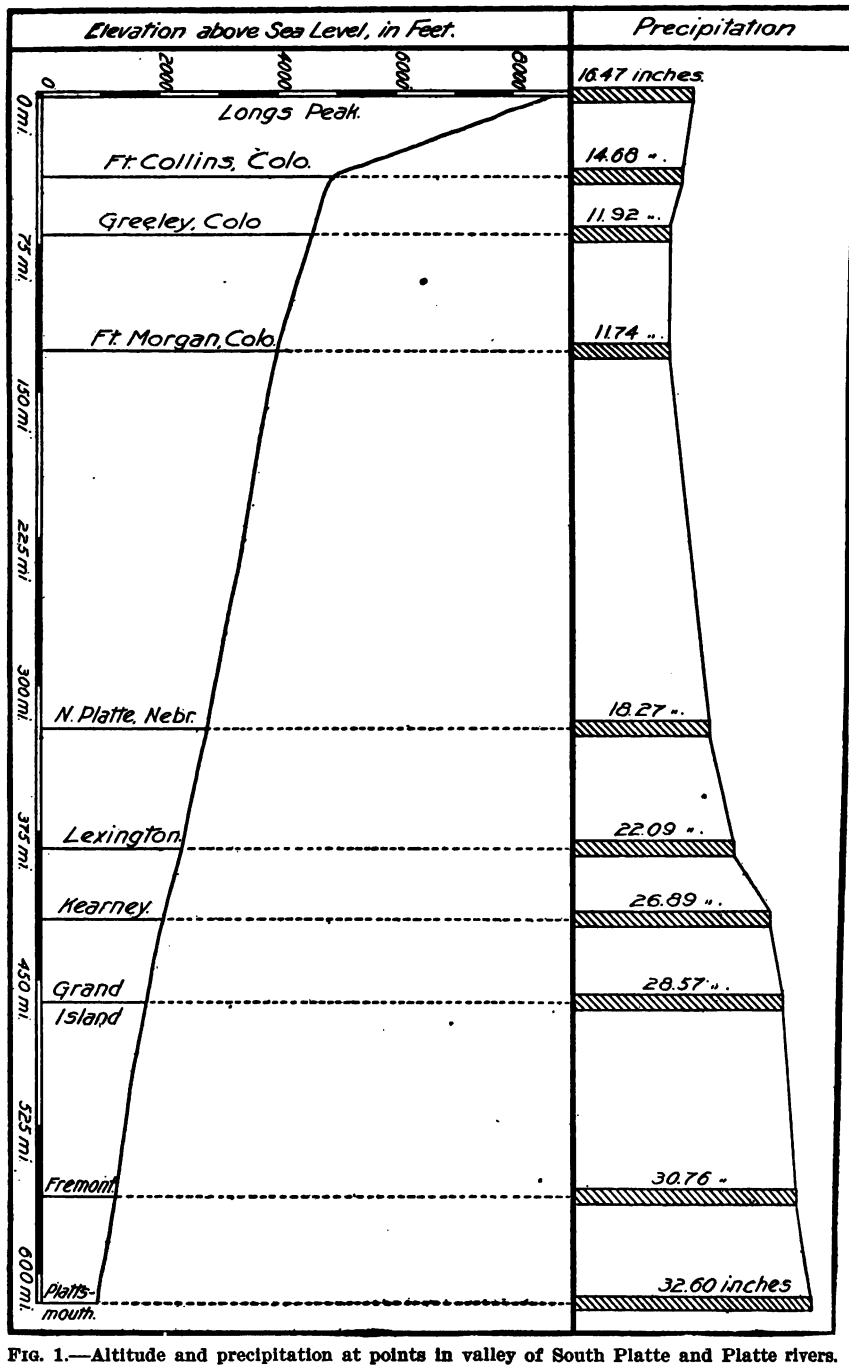


FIG. 1.—Altitude and precipitation at points in valley of South Platte and Platte rivers.

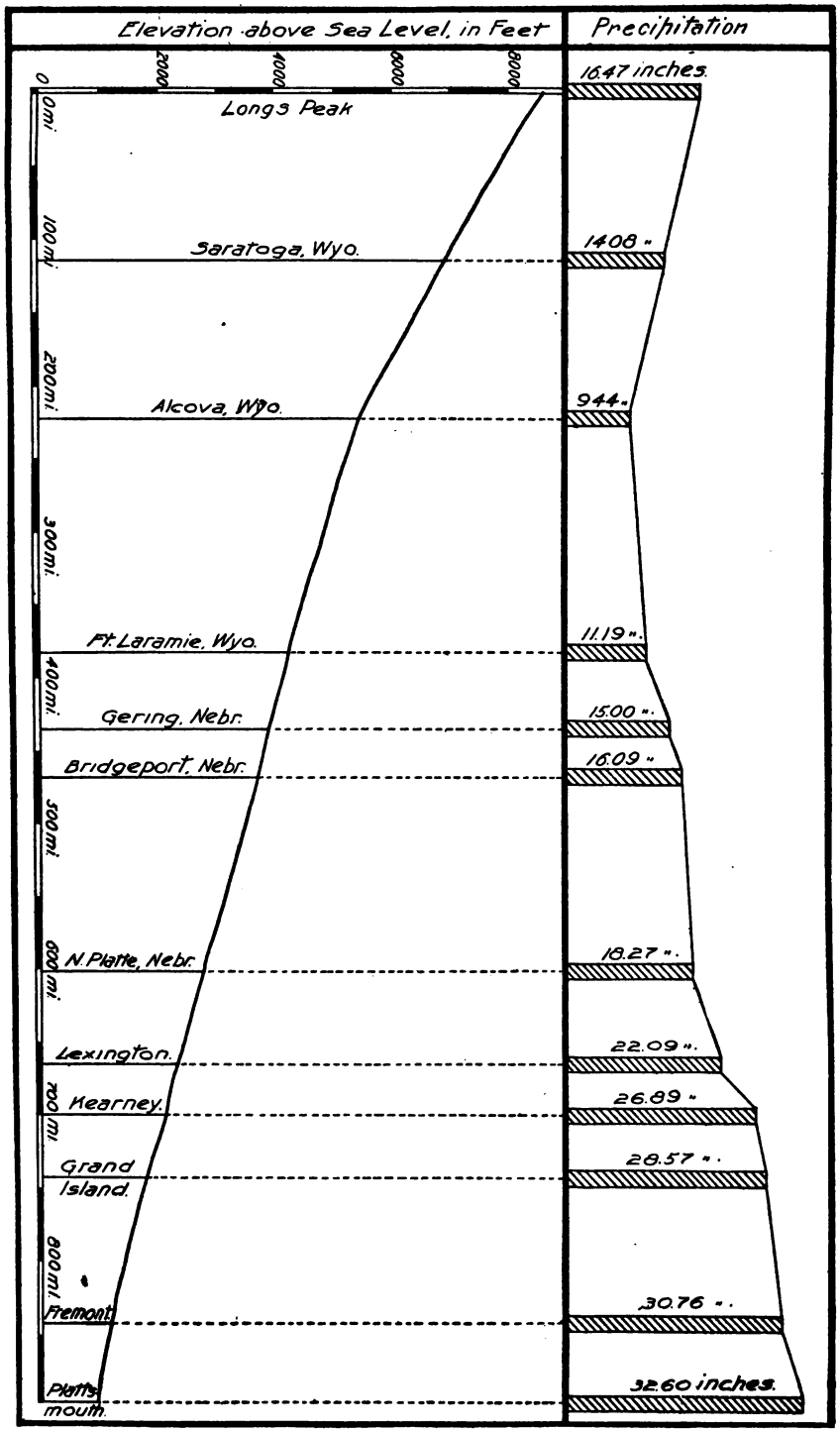


FIG. 2.—Altitude and precipitation at points in valley of North Platte and Platte rivers.

arid zone extends from the mountains to North Platte, Nebr. East of North Platte some farms are irrigated, while others are not, the proportion of irrigated to unirrigated farms gradually diminishing to the east; that is, all the agricultural lands along the branches of the Platte River in Colorado and Wyoming require irrigation. Those in Nebraska, as far east as North Platte, are in the same condition, while those east of North Platte have less need of it.

SOUTH PLATTE AND TRIBUTARIES.

The water supply of the South Platte Valley comes almost entirely from streams fed by the snows and rains in the mountains, and is largest in the early summer and smallest in the late summer. The South Platte itself is a mountain stream, and receives also the discharge of a number of other streams coming from the eastern slope of the Rocky Mountains. The flow of these streams at stations near the mountains where records have been kept is shown in the following table:

Mean monthly flow of South Platte River and tributaries.

Stream.	April.	May.	June.	July.	August.	September.
	Cu. ft. per sec.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
South Platte at Deansbury	432	747	669	497	276	181
Bear Creek at Morrison	123	156	160	98	91	47
Clear Creek at Forks Creek	120	526	382	496	221	113
Boulder Creek near Boulder	91	359	507	321	149	64
St. Vrain Creek near Lyons	164	363	625	376	181	91
Big Thompson River at Arkins	151	501	808	452	207	103
Cache la Poudre above Fort Collins	499	1,495	1,985	781	320	175
Total	1,580	4,147	5,586	3,020	1,445	774

All these tributaries are located on the north and west side of the river. There are in addition a number of torrential tributaries on the south and east sides, which carry large volumes of water during heavy storms. Below the mouth of the Cache la Poudre several torrential streams come in on both sides of the river. These are shown on the map (Pl. I). These streams are of little value for irrigation without storage, since the flow is so uncertain and lasts but a few hours or days at a time; but with storage they become valuable sources of irrigation water. Reservoirs have been built on some of these streams and more will probably be built.

There is considerable irrigation above the points of measurement on the streams given in the table. There are small tributaries for which no measurements are available, and the measurements for the streams given cover different periods. The volume given for each month for each stream is the average of whatever measurements are

available. Therefore, the table is not to be taken as exact, but it gives a general idea of the average available water supply for the lands in the South Platte Valley. The average total supply for the period from April to September, inclusive, is 2,765 cubic feet per second. Against this supply, rights[a] aggregating 30,597.47 cubic feet per second have been recognized by public authorities in Colorado and Nebraska. (See p. 39.) That is, the rights to be supplied by this river system are more than ten times as great as the average flow of the streams. This statement of averages does not, however, give a correct idea of the relation between water supply and water rights. Many canals were built with the full understanding that water could be obtained only at intervals, and the frequency and duration of floods are of more importance to their owners than average flows. The conditions are more correctly represented by the tables given below, showing the maximum, minimum, and mean discharges of the South Platte at Deansbury and of the Cache la Poudre above Fort Collins, with the differences between these discharges and the sum of all decreed rights to water.

The table which follows gives the maximum, mean, and minimum flows of the South Platte at Deansbury, Platte Canyon, or South Platte for the years 1890–1892 and 1896–1903. The maximum for each month is the greatest discharge reported for that month during the period covered, rather than the mean maximum. The minimum is obtained in the same way. The sum of the decreed rights to water from the South Platte between the point of measurement and Denver is approximately 1,913 cubic feet per second. The differences between this volume and the discharges of the stream are shown in the last column of the table.

[a] Rights to water are theoretically based on use, and no one has a right to more water than he has put to use. However, the courts have decreed to some parties rights to more water than they have used and more than their ditches can carry. On the basis of the decrees the parties have these rights, while on the basis of the theory the rights do not exist. The figures given here are based on the decrees. (See pp. 26–39.)

Discharge of South Platte River at Deansbury, Platte Canyon, or South Platte, 1890–1892 and 1896–1903.

Month.	Stage.	Discharge.	Greater (+) or less (−) than rights.
		Cubic feet per second.	*Cubic feet per second.*
April	Maximum	2,445	+ 532
	Mean	432	−1,481
	Minimum	98	−1,815
May	Maximum	2,685	+ 772
	Mean	747	−1,166
	Minimum	63	−1,850
June	Maximum	2,175	+ 262
	Mean	669	−1,244
	Minimum	60	−1,853
July	Maximum	2,195	+ 282
	Mean	497	−1,416
	Minimum	55	−1,858
August	Maximum	1,365	− 548
	Mean	276	−1,637
	Minimum	21	−1,892
September	Maximum	764	−1,149
	Mean	182	−1,731
	Minimum	57	−1,856

The table shows that while the average flow for no month equals one-half of the sum of the decreed rights, at times during the months of April, May, June, and July there has been more than enough water to supply all decreed rights, leaving some water to flow down to lower ditches. On the other hand, the table shows that there have been times in each month when the flow of the stream does not equal one-twentieth of the decreed rights in this one section. Some of the ditches farther down on the river have decreed rights which must be supplied from this flow, but the river receives some tributaries below, so that the table does not present the exact situation, although it gives a good illustration of the general condition on the South Platte. At times there is more water than all the ditches can divert; at other times only a few can be supplied, with the average far below the sum of the rights.

The following table gives similar facts for the Cache la Poudre. The record extends from 1894 to 1903, inclusive. The sum of decreed rights to the river below the point of measurement, where the river leaves the mountains about 12 miles above Fort Collins, is 3,988 cubic feet per second.

Discharge of Cache la Poudre River above Fort Collins, 1894–1903.

Month.	Stage.	Discharge.	Greater (+) or less (−) than rights.
		Cubic feet per second.	*Cubic feet per second.*
April	Maximum	2,964	−1,054
	Mean	521	−3,467
	Minimum	74	−3,914
May	Maximum	5,100	+1,212
	Mean	1,495	−2,493
	Minimum	200	−3,788
June	Maximum	4,376	+ 388
	Mean	1,985	−2,003
	Minimum	559	−3,429
July	Maximum	2,701	−1,287
	Mean	776	−3,212
	Minimum	200	−3,788
August	Maximum	974	−3,014
	Mean	320	−3,668
	Minimum	91	−3,897
September	Maximum	488	−3,500
	Mean	180	−3,808
	Minimum	43	−3,945

This table shows that at times in May and June the discharge of the Cache la Poudre is large enough to supply all decreed rights and leave some water to pass down the stream. The mean for June equals almost exactly one-half of the decreed rights, while the minimum for June, the month of largest flow, is about one-seventh of the sum of the rights. The minima for May and July are about one-twentieth of all the rights, the minimum for August is about one forty-fourth of the rights, that for April is about one fifty-fourth, and that for September about one ninety-third.

The areas irrigated and the number of ditches and reservoirs along the South Platte and tributaries in Colorado, as reported to the State engineer, are given below. The areas are stated in round numbers and are only approximate. It is the opinion of the State engineer that they are over rather than under the truth. For administrative purposes the State is divided into districts, as shown on the map. (Pl. I.) The areas are given by districts.

Ditches, reservoirs, and areas irrigated on South Platte and tributaries in Colorado.

District.	Ditches.		Reservoirs.		Area irrigated.
	Number.	Length.	Number.	Capacity.	
		Miles.		*Acre-feet.*	*Acres.*
No. 23	235	311	.....	.....	67,213
No. 8	95	291	20	.....	23,781
No. 9	19	66	20	15,076	8,193
No. 7	32	265	.....	.....	92,895
No. 6	40	281	16	4,000	72,061
No. 5	36	267	32	11,506	85,513
No. 4	17	158	35	44,320	91,922
No. 3	48	352	35	103,257	174,885
No. 2	26	289	6	7,426	68,762
No. 1	34	242	2	.....	71,640
No. 64	17	.....	.....	.....	35,953
Total	600	2,522	166	185,585	792,838

There is little irrigation along the South Platte in Nebraska. The report of the State board of irrigation for 1901–2 shows 14 ditches, with a total length of 107 miles, covering 43,300 acres. No statement is given showing the part of the land under ditch which is irrigated, but it does not exceed one-half. There are no reservoirs along this section of the river.

None of the above figures, showing water supply, water rights, number of ditches and reservoirs, and acreages irrigated should be taken as exact, but they give a general view of conditions in the South Platte Valley. In the upper districts along the main river agriculture is not highly developed, but large areas of hay and grain are raised. In the vicinity of Denver, both on the main stream and the tributaries to the north of Denver, large areas are devoted to small fruits and vegetables. To the north of this, on the tributaries, is the section where the storage of water has made possible the raising of potatoes and sugar beets, and increased yields of alfalfa.

Below these tributaries on the main stream the stage of development declines steadily, not only throughout the course of the stream in Colorado, but on to its mouth in Nebraska. But the construction of reservoirs and the accompanying advance in the values of crops raised is gradually progressing down the stream and may be expected to continue to do so.

Records of the diversions of water by the principal ditches in seven out of ten districts, Nos. 3, 4, 5, 7, 9, 2, 1 (see map, Pl. I), in Colorado were obtained by Mr. Adams in 1903, and crop returns under five ditches, covering 24,329 acres, were also secured. Mr. Adams sums up his results as follows:

> During the irrigation season of 1903, the farmers of Colorado used in irrigation practically the entire flow of South Platte River and tributaries, besides diverting a small supplemental supply from the basins of Grand, North Platte, and Laramie rivers. During the preceding nonirrigating period and after the irrigation season of 1903, the flow of the principal tributaries was almost wholly diverted into reservoirs, the total amount stored for use in 1903 having been over 200,000 acre-feet. The seasonal mean of the daily diversions by the principal ditches of the South Platte system except those in district 23, in part estimated, was about 2,600 cubic feet per second. Running continuously from May through September, this amounted to 788,996 acre-feet, and at the average return per acre-foot used under five representative ditches in South Platte basin made possible a gross return of $4,623,517. Adding to this the return made possible by the 200,000 acre-feet of stored water figured at the same rate, which is low for stored water, the total return to the farmers of Colorado situated in this basin was over $5,500,000. The irrigation season began in April in some of the districts and lasted through November on the main South Platte below Denver.

To this should be added the returns from 122 small ditches scattered throughout all the districts. The ditches for which crop returns were secured are not those where the highest returns are

secured and were probably below the average; the total given by Mr. Adams is therefore considerably less than the actual return secured from the irrigated farms in the South Platte Valley in Colorado. This complete utilization of the water supply and the raising of high-priced crops have been made possible only by the development of methods of distribution and exchange which are probably not equaled anywhere else in the United States.[a]

NORTH PLATTE AND TRIBUTARIES.

The North Platte River rises in North Park, Colorado, between the Medicine Bow Mountains on the east and the Park Range on the west, which, with the Continental Divide on the west, form a horseshoe-shaped area comprising about 1,700 square miles in Colorado. The valley in this section has a general altitude of about 8,000 feet, and the mountains surrounding it rise to 10,000 to 12,000 feet. The streams draining these mountains unite in the center of North Park to form the North Platte River. Near the Colorado-Wyoming line the river enters a succession of canyons separated by stretches of rolling hills. This formation extends for about 20 miles, beyond which the river enters a rolling country. The hills are not so high as those farther south and occasionally recede from the stream, leaving areas of bottom land varying from 10 to 1,000 acres in extent. These bottom lands are irrigated, usually not from the river itself, but from mountain tributaries. Beaver, French, Brush, Cow, and Encampment creeks enter the river in this section. Farther down the valley broadens until it reaches a width of 1 to 3 miles on the west side and an average of about 4 miles on the east. This valley extends for 50 miles to the Union Pacific Railroad at Fort Steele. In this valley the river receives the discharges of Jack, Sage, Spring, and Pass creeks. The estimated area which can be reclaimed by irrigation in this valley is about 125,000 acres. The river receives its greatest perennial supply from these tributaries entering it in the section above Fort Steele. Irrigation is practiced to some extent in the valleys of these tributaries.

From Fort Steele the river flows through precipitous hills for about 35 miles to the Seminole Mountains. The country on both sides is badly broken, and is used only for grazing. In this section the river receives the discharge of the Medicine Bow River, which rises in the Laramie Mountains. Irrigation is practiced along the course of the Medicine Bow. From the mouth of the Medicine Bow to the mouth of the Sweetwater River the land along the North Platte becomes more and more sandy, until vegetation practically disappears. From the mouth of the Sweetwater the river still flows through broken roll-

[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 92, 118, and 134.

ing hills until it reaches Sevenmile Canyon. The walls of this canyon rise almost perpendicularly to a height of about 2,000 feet above the river bed. Beyond Sevenmile Canyon the river flows through another stretch of hilly country, then enters the Alcova Canyon. From Alcova to Casper the river is bordered by a high, level plateau. Between Alcova and Casper, Bates Creek, Poison Spider Creek, and Casper Creek enter the North Platte. These streams are not perennial, but are used for irrigation in the spring. There is almost no irrigation from the North Platte between Fort Steele and Casper, and little land which can be irrigated. Narrow strips of bottom lands along the tributaries are, however, irrigated, and this area is being constantly extended. From Casper to Orin the river flows in a wide valley, winding back and forth across this valley in a sandy bed. In times of low water it is divided into several channels.

Surveys have been made for a number of canals to cover parts of this valley, but only one has been completed, and it is now out of repair. This section, however, affords some of the best examples of irrigation in the Platte Valley. Many ditches divert the waters of the tributaries of the Platte, reservoirs have been built, and the complete utilization of the water supply in the near future is assured. In this section, between Casper and Orin, Big Meadow, Deer, Box Elder, La Prelle, Wagon Hound, and La Bonte creeks enter the river. These streams are all used for irrigation, and supply very little water to the main stream. Below Orin on each side of the river for a distance of 5 or 6 miles there is considerable irrigated land, which is watered by three ditches, the largest of these being about 10 feet on the bottom and 2 feet deep. Ten miles below Orin the river enters broken country, with occasional stretches of land which could be reclaimed by lifting water from the river. The valley broadens again at Guernsey, this valley extending to and beyond the State line. Several good-sized ditches take water from the river in this section and irrigate considerable areas of land. Other canals which are under construction will irrigate between 25,000 and 50,000 acres. Elkhorn, Horseshoe, Cottonwood, and Rawhide creeks and the Laramie River enter the river in this section.

LARAMIE RIVER.

The Laramie River rises in northern Colorado in the vicinity of the other streams which go to form the North Platte and flows through Wyoming in a course generally parallel to the North Platte, the two coming together near the Wyoming-Nebraska line. There is little irrigation along the Laramie in Colorado; some of its water is, however, carried over the divide separating its headquarters from those of the Cache la Poudre, and is used in the valley of the latter

stream. In Wyoming the Laramie is extensively used for irrigation. Not far from the Colorado-Wyoming line it enters the Laramie Plains, which comprise an extended area of high level land, much of which is under ditches taking water from the Laramie. Below the Laramie Plains irrigation is confined to narrow strips bordering on the stream. The Wheatland Flats, which lie between Sybile and Chugwater creeks, where some 65,000 acres is irrigated, are served by water taken out of the Laramie through a tunnel into Sybile Creek.

The areas irrigated from the tributaries of the North Platte in Wyoming are given with close approximation in the order establishing rights to water and in the subsequent certificates of appropriation issued by the board of control. These amount in the aggregate to 360,000 acres. It has been estimated that about 53,000 acres are irrigated from the North Platte itself.

THE NORTH PLATTE IN NEBRASKA.

The stream throughout its course in Nebraska is bordered by a valley of considerable width, back of which are the high plains, where the areas which can be reclaimed are limited only by the water supply. One large canal heads immediately above the Wyoming-Nebraska State line and carries water to land in Nebraska. Two other large canals head immediately east of the State line in Nebraska. Lands immediately adjoining the river throughout its length to the junction with the South Platte are under ditch, except for small areas where the hills come down to the river bank. The largest irrigated areas lie in the section from the State line to Bridgeport, a distance of about 75 miles, and in the point of land between the two rivers for a distance of about 20 miles west of the junction. One canal taking water from the North Platte crosses the South Platte and covers land on the south side of that stream.

Below the junction the valley on the north side of the river slopes gradually up to the hills, and these hills are low, so that canals can be easily built to cover land at long distances from the stream. On the south side the hills are higher and come closer to the river. A number of large ditches have been built to cover the lands on the north side as far as the city of Kearney, which is about 90 miles below the junction. Short canals cover some land on the south side.

The report of the State board of irrigation of Nebraska for 1901–2 states that the canals diverting water from the North Platte, in Nebraska, have an aggregate length of 780 miles and cover 338,220 acres. The canals on the main stream below the junction have an aggregate length of 296.5 miles and cover 179,440 acres. Not all of this land under ditch is irrigated, but it is impossible to make any

estimate as to what portion is watered. Along the North Platte irrigation is necessary for the raising of crops, so that a considerable portion of the land under ditch is watered. Below the junction crops can be raised without irrigation in most years, and some of the large canals, although they cover extended areas, supply very little water for irrigation.

Along the North Platte, in Colorado, the chief crop is native hay. Owing to altitude few other crops can be raised. Hay was the first crop grown in Wyoming, also, but in recent years diversified farming has been constantly gaining ground, until from Casper to the State line the crops are of the same general character as those grown along the South Platte. Along the Laramie, in Colorado, and on the Laramie Plains the crops irrigated are chiefly native hay and alfalfa, although some grain and vegetables are raised on the Laramie Plains. At Wheatland general farm crops are grown, including alfalfa, grain, corn, and potatoes. Experiments have been made with sugar beets, showing that they can be successfully grown here. In Nebraska general farm crops and some small fruits are raised. Potatoes have become an important crop in this section, and some sugar beets also are grown. Along the main river below the junction large areas of corn are raised, usually without irrigation, but in some seasons corn is watered.

It will be seen that conditions along the North Platte differ widely from those on the South Platte. Near the base of the mountains on the South Platte and its tributaries agriculture has reached a very advanced stage of development, while along its lower reaches the lands are now being reclaimed, and low-priced crops are chiefly raised. On the upper sections of the North Platte the low-priced crops are grown, while the more highly developed agriculture is found on the lower reaches of the stream. Nowhere on the North Platte, however, has agriculture reached such an advanced stage as is found in places on the South Platte and its tributaries.

The areas irrigated from the North Platte and tributaries are reported as follows:

Areas irrigated from the North Platte River and tributaries.

	Acres.
Colorado	157,965
Wyoming	413,000
Nebraska	338,220
Total	909,185

On the main river below the confluence the area under ditch is reported by the State board of irrigation as 179,440 acres.

Few records of the flow of the North Platte and its tributaries have been made. No records of the flow in Colorado have been kept. A

record was kept for a part of the season of 1903[a] at Saratoga, Wyo. This is given as follows:

Discharge of North Platte River, at Saratoga, Wyo., 1903.

	Cubic feet per second.
June:[b]	
Maximum	8,000
Mean	6,306
Minimum	3,580
July:	
Maximum	2,912
Mean	1,236
Minimum	465
August:	
Maximum	465
Mean	300
Minimum	220
September:	
Maximum	754
Mean	518
Minimum	206
October:	
Maximum	700
Mean	614
Minimum	490
Average	1,490

This does not, however, represent the supply for the lands below Saratoga, as below that point the river receives many tributaries for which no records are available.

Since 1894 the Wyoming State engineer's office has kept records showing the flow of the North Platte at Douglas, Orin, or Guernsey. Douglas and Orin are not far apart, and Guernsey is about 60 miles below Douglas. In the table which follows the measurements are averaged as if all were made at the same point. It is not believed that the discharge varies enough between these points to introduce any considerable error. Laramie River and Horse Creek enter the North Platte below Guernsey, but the present and prospective storage of the flow of these streams makes the supply at Guernsey a fair approximation of what is available for future extension of the irrigated area along the North Platte below that point. Rights below this point aggregate 11,172.66 cubic feet per second, a little less than three times the average flow of the stream for the irrigation months. This includes rights to water from the main Platte, since it receives its principal supply from the North Platte.

In the table the maximum, minimum, and mean discharges of the

[a] Discharge table made from data supplied by A. J. Parshall, U. S. Geological Survey.

[b] 21 days, 10th to 30th, both inclusive.

river are given, with a column showing the difference between each discharge and the sum of the decreed rights:

Discharge of North Platte River at Douglas, Orin, or Guernsey, Wyo., 1894–1903.

Month.	Stage.	Discharge.	Greater (+) or less (−) than rights.
		Cubic feet per second.	*Cubic feet per second.*
April	Maximum	13,420	+ 2,247
	Mean	3,728	− 7,445
	Minimum	600	−10,573
May	Maximum	19,093	+ 7,920
	Mean	7,718	− 3,455
	Minimum	2,500	− 8,673
June	Maximum	22,985	+11,762
	Mean	8,767	− 2,406
	Minimum	1,684	− 9,539
July	Maximum	17,770	+ 6,597
	Mean	2,602	− 8,571
	Minimum	600	−10,573
August	Maximum	2,400	− 8,773
	Mean	772	−10,401
	Minimum	220	−10,953
September	Maximum	1,085	−10,088
	Mean	523	−10,650
	Minimum	80	−11,093

The table shows that at times during the months of April, May, June, and July there is more than enough water to supply all decreed rights in full, the highest flood discharge for June being more than double the sum of these rights. In no month does the average flow equal the sum of the rights, although the average for June approaches it. The serious shortage occurs in August and September. The table shows that there is still a large supply of water available for storage during the summer, in addition to the winter flow.

With decreed titles to water from the South Platte and tributaries aggregating more than ten times the supply at the foot of the mountains, and from the North Platte and Platte amounting to about three times the average supply, it is evident that all can not receive all the water to which they are nominally entitled. It is this scarcity of water as compared to the claims which makes the relation of rights a matter of importance. When there is not water enough for all, who shall receive what there is? Have the people of one State a better right to this water than those of another, or are their rights to be determined regardless of State lines? To what extent does use by parties on one section of a stream deplete the supply for others on a lower section? Or, to make it specific, what effect does the use of water of the South Platte in Colorado have on the flow of the stream in Nebraska? What effect has the use of water from the North Platte in Colorado on the supply in Wyoming? And what effect has the use of water from the North Platte in Wyoming on the supply for holders of rights in Nebraska? One further question is rendered important by the scarcity of water. When it is decided

who is entitled to the water, how are their rights to be protected? The answering of these questions requires a study of the existing systems of water rights in the States, and of the character of the streams.

RIGHTS TO WATER.

In the arid region irrigation began before the adoption of any laws regarding the diversion of water from streams and its use in agriculture. As a result, the irrigation codes of the States have had a gradual growth, laws being enacted from time to time in response to changing conditions as the use of the streams for irrigation has progressed, and decisions defining the nature of rights being handed down as new conflicts have arisen. This process is still going on, and, therefore, there are many things regarding rights to water which can not be considered settled. However, some principles have been recognized in the constitutions and laws of the States, and others have been decreed and so often reaffirmed by the courts that they may be considered finally settled.

The early settlers found that they needed to put water upon the land in order to grow crops. They therefore built ditches and took the water from the streams without formality and without restriction. This came to be called appropriation of water, and the right to take water in this way was called the right of appropriation.

As diversions were made, the time came when new diversions lessened the supply of some of those who had already used water. Simple justice demanded that the person who had dug a ditch, improved his land, and used water be protected in that use, since taking the water away from him destroyed the value of his property. The superiority of the right of the first users over the rights of those making later diversions was recognized by common custom and by laws, and is known as the principle of priority.

On the other hand, justice and the public welfare demand that the holder of the early right shall take only such water as he needs, leaving as large a supply as possible for later comers. It is, therefore, required that the water taken from streams be put to a beneficial use and not wasted.

The right of appropriation and the principles of priority and beneficial use have been recognized by the States of Colorado, Wyoming, and Nebraska. Each of these States has also recognized the necessity of providing for the distribution of the water of its streams to those entitled to it, and has provided officials for this purpose. These general features of the laws have been fully discussed in previous bulletins of this Office.[a]

[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 58, 60, 70, 96, 118, and 140.

RIGHTS TO WATER FROM SOUTH PLATTE AND TRIBUTARIES.

Preliminary to enumerating the rights to water from the South Platte which have been acquired in the States of Colorado and Nebraska it may be well to state briefly the status and nature of rights in the two States. In Colorado rights are acquired by diversion and use without public supervision, are defined by the courts, and when defined and after the expiration of the two years allowed for appeal are considered absolute rights to the quantity of water stated in the decrees. (See p. 92.) These rights can be sold and transferred under direction of the court, if others are not injured by the transfer. (See p. 88.) This quantity, as a rule, bears no relation to the area irrigated or the needs of the holder of the right. (See p. 92.) Rights are enforced by State officials. Rights in Nebraska have been acquired in the same way as in Colorado up to the enactment of the law of 1895; since that time they have been acquired by application to the State board of irrigation, and the diversion and use of the water, are defined by the board or the courts, and enforced by State officials. The right is to sufficient water for the land to be irrigated, not to a fixed quantity of water; is attached to a particular tract of land, and can not be transferred to other land. (See p. 87.) The facts given in the following pages regarding the water-right decrees, both as to the nature of the decrees and the quantities of water decreed, are taken from the report of W. B. Dunton.

COLORADO.

District 23.—District 23 comprises the country which is known as South Park, which is drained by the headwaters of the South Platte. (See map, Pl. I.) The decree which governs practically all the rights in this district was rendered in August, 1889. It includes ditches with priorities dating from 1861 to 1888, and covers all the rights which have been decreed, with the exception of a few small ones amounting to 105.62 cubic feet per second, which have been adjudicated since. The decree awards the water to the various ditches on the basis of their respective capacities. Each appropriator was awarded unconditionally the full amount of water which he claimed his ditch would carry, regardless of whether he had applied that amount to a beneficial use. No attention was paid to the areas of land actually irrigated, but statements were given of the areas " to be watered " by the ditches; however, the amounts of water awarded bore no relation to the acreages stated. In almost all cases about twice, and in many cases from three to ten times, the amount of water which the ditches would actually carry were decreed. Not long after the adjudication 40 of the ditches whose rights were adjudicated were gauged by an engineer. Only 8 out of the 40 had capacities equal to the right

decreed them. The combined capacity of these ditches as measured was 543.97 cubic feet per second, while they were decreed rights to 1,358.95 cubic feet per second. The total amount of the rights as finally established by the decree probably bears about the same proportion to the total amount of water which the ditches could carry.

District 23 is the highest district on the South Platte River. Rights in this district are theoretically subject to prior rights in all the lower districts on the river—districts 8, 2, 1, and 64—but so far no attempt to close down these ditches has been made, owing in part to the belief that the water is used very largely on hay lands close to the river and returns so quickly to the river that its use has little effect on the flow, and in part to the opposition on the part of the holders to any regulation by the State officials. The table which follows shows the total amount of the rights acquired in each year and the sum of the rights antedating these in the lower districts to which rights in district 23 are theoretically subject:

Rights to water in district 23 and prior rights in lower districts.

Year.	Rights in district 23.		Prior rights in lower districts.	Year.	Rights in district 23.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1861	39.49	39.49	96.77	1880	150.35	1,902.29	5,115.31
1866	53.46	92.95	660.82	1881	412.75	2,315.04	5,212.81
1867	106.56	199.51	772.33	1882	446.61	2,761.65	5,659.02
1868	26.32	225.83	808.60	1883	49.87	2,811.52	6,692.29
1871	10.00	235.83	968.06	1884	241.71	3,052.23	6,847.69
1872	12.70	248.53	1,417.70	1885	186.48	3,238.71	6,967.69
1873	97.93	346.46	1,534.18	1886	157.21	3,395.92	7,317.69
1874	144.50	490.96	2,117.36	1887	163.87	3,559.79	7,479.19
1875	227.11	718.07	2,315.86	1888	679.27	4,239.08	7,499.19
1876	299.71	1,017.78	2,688.50	1889	20.00	4,259.08	8,104.19
1877	206.89	1,224.67	2,952.07	1890	30.00	4,289.08	8,301.79
1878	166.91	1,391.58	3,076.75	1891	30.00	4,319.08	8,304.79
1879	360.36	1,751.94	3,386.21				

The total amount of the rights in this district is 4,319.08 cubic feet per second decreed to 219 ditches. No records of the flow of the streams supplying this district or of the diversions made in the district have been kept. The total area irrigated, as reported by the water commissioner for 1903, was 67,213 acres, or about 16 acres per cubic foot per second of the amount decreed.

District 8.—District 8 includes the section of the South Platte River between the mouth of Platte Canyon and the mouth of Clear Creek and the tributaries of the Platte in this section. The first decree in this district was rendered in 1883 and governs the rights of all ditches which take water from the South Platte River itself. A later adjudication took place in 1890, by which a few ditches with

late priorities and a number of reservoirs all supplied from tributaries had their rights defined. The original decree unconditionally awarded each ditch a volume of water equaling its full capacity. The later decree also computed rights on the basis of the capacities of the ditches. Since 1890 a number of petitions to have rights defined have been brought by parties who neglected to come into the general adjudication. The court has denied none of these petitions, but has awarded the volumes claimed. About 15 ditches have obtained such decrees, giving them priorities dating from 1862 to 1889. A number of the reservoirs in this district have decreed rights also.

Rights in this district are subject to prior rights in districts 2, 1, and 64. The following table gives the decreed rights in district 8, by years, and the sum of the prior rights in the lower districts:

Rights to water in district 8 and prior rights in lower districts.

Year.	Rights in district 8.		Prior rights in lower districts.	Year.	Rights in district 8.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1860	67.00	67.00		1868	32.00	354.38	469.71
1861	54.30	121.30		1873	40.00	394.38	1,250.59
1862	22.50	143.80	29.77	1878	285.83	680.21	2,708.96
1863	34.00	177.80	77.65	1879	1,184.00	4,864.21	2,732.59
1864	79.01	256.81	167.21	1882	42.95	1,907.16	3,821.40
1865	34.30	291.11	224.06	1883	5.40	1,912.56	4,811.72
1867	31.27	322.38	469.71				

There are in this district 95 ditches, with total decreed rights to 1,912.56 cubic feet per second. To supply this water in the season of 1903 the maximum flow of the river at Platte Canyon was 1,284 cubic feet per second for a single day. There was 300 cubic feet per second or over in the river on only thirty-one days and 200 cubic feet per second or over on only seventy-three days. Only two ditches received water throughout the seven months of the irrigating season. Five received some water in six months, and one, the largest ditch in the district, received water on only eleven days out of the season. Many of the ditches in this district have rights prior to those in district 23 above, but no effort has been made to close ditches in the upper district to supply ditches in district 8.

In addition to the water decreed to ditches as stated above, many reservoirs have decreed rights. These can be filled only outside the irrigation season or when there is more water than is needed for direct irrigation. No statement of the total quantity of water to be stored by these reservoirs can be made, owing to the fact that not all the decrees give the capacities of the reservoir.

District 9.—District 9 comprises the drainage area of Bear Creek and its tributaries. The decree governing rights in this district was rendered in 1883. Each ditch was decreed the amount of water the referee found to be its full carrying capacity. These findings of the referee were based on measurements made by a civil engineer employed for that purpose, so that there is probably not the same excess in rights decreed over actual capacities that there is in other districts. The ditches on Bear Creek can be supplied from no other source, but their rights are subject to prior rights on the main river. These ditches are occasionally closed down to supply prior rights below.

The following table gives the decreed rights in district 9 and the prior rights in the lower districts:

Rights to water in district 9 and prior rights in lower districts.

Year.	Rights in district 9.		Prior rights in lower districts.	Year.	Rights in district 9.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1859	11.58	11.58	----------	1868	17.21	281.14	469.71
1860	35.76	47.34	----------	1869	7.94	289.08	581.22
1861	32.99	80.33	----------	1870	1.49	290.57	634.61
1862	50.59	130.92	29.77	1871	28.42	318.99	682.19
1863	30.86	161.78	77.65	1874	12.00	330.99	1,793.07
1864	25.47	187.25	167.21	1878	26.68	357.67	2,708.96
1865	67.74	254.99	224.06	1881	4.01	361.68	3,375.19
1867	8.94	263.93	469.71	1882	75.87	437.55	3,821.40

The average flow of Bear Creek during the late summer, when there is likely to be a shortage of water on the main river, is considerably less than 100 cubic feet per second, and rights to this quantity in district 9 are prior to any rights on the main river below. Of the eighteen ditches in the district three received some water in each month of the season, and almost all of them received what was needed by the land under them during May, June, July, and August. The average daily diversion by all the ditches for the season of 1903 is reported as 94 cubic feet per second.

Eleven reservoirs in district 9 have decreed rights. These rights are based on the capacities of the inlet ditches, the sum of the rights being 212.98 cubic feet per second. This water can be diverted only outside of the irrigation season or when there is more water than is needed for direct irrigation. There are several other reservoirs, the rights of which have not been defined.

District 7.—District 7 includes the drainage area of Clear Creek and its tributaries. Clear Creek discharges into the South Platte at the boundary line between districts 8 and 2, and the water of Clear

Creek not used in district 7 can be used to supply rights in district 2, 1, and 64. Rights in this district were decreed on the basis of the carrying capacities of the ditches.

The following table gives the volumes of water decreed to the ditches in district 7 and the prior rights in the districts below:

Rights to water in district 7, and prior rights in lower districts.

Year.	Rights in district 7.		Prior rights in lower districts.	Year.	Rights in district 7.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second*
1860	76.43	76.43		1872	154.00	772.16	1,183.6
1861	139.11	215.54		1873	118.23	890.39	1,250.9
1862	40.15	255.69	29.77	1874	138.26	1,028.65	1,738.6
1863	40.86	296.55	77.65	1877	18.26	1,046.91	2,584.2
1864	50.94	347.49	167.21	1878	52.74	1,099.65	2,708.9
1865	142.51	490.00	224.06	1881	32.34	1,131.99	3,575.9
1866	2.80	492.80	469.71	1883	48.46	1,180.45	4,811.7
1867	36.20	529.00	469.71	1889	33.60	1,214.05	6,238.2
1868	23.14	552.14	469.71	1891	5.00	1,219.05	6,309.2
1869	31.08	583.22	581.22	1893	15.00	1,234.05	6,337.2
1871	34.94	618.16	682.19	1895	335.86	1,569.91	6,464.2

Six reservoirs have decreed rights, some rights being based on the capacities of inlet ditches and some on the capacities of the reservoirs. There has been a great deal of litigation between ditch owners in this district and those in district 2 in attempts to close down the ditches in district 7, to supply water to earlier ditches in district 2. This litigation has been continuous since 1888. The suits have usually taken the form of applications for injunctions restraining the State officials from closing the head gates of the ditches in the upper district, and have usually been successful. Such an injunction was still in force in 1903. The district court in a suit brought in 1904 stated that the State officials had failed to close ditches with late rights in district 23, and until officials enforced the law in that district there was no justice in making other districts supply the water which should be supplied by district 23.

District 6.—District 6 comprises Boulder Creek and its tributaries, including Coal Creek. Boulder Creek is a tributary of St. Vrain Creek. A decree covering the rights of 69 ditches in this district was rendered in 1882. The volumes decreed to these ditches were based upon estimates of their capacities made by a civil engineer employed for that purpose. Each ditch was decreed a volume of water equal to its full capacity as estimated by the engineer.

The following table gives the rights in district 6 and the prior rights in districts 2, 1, and 64:

Rights to water in district 6 and prior rights in lower districts.

Year.	Rights in district 6.		Prior rights in lower districts.	Year.	Rights in district 6.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1859	116.85	116.85		1872	221.23	2,550.47	1,133.41
1860	108.79	225.64		1878	378.17	2,928.64	1,250.59
1861	58.66	284.30		1875	195.29	3,123.93	1,979.57
1862	348.82	633.12	29.77	1876	81.00	3,204.93	2,352.21
1863	356.54	989.66	77.65	1878	94.56	3,299.49	2,708.96
1864	154.08	1,143.74	167.21	1879	60.60	3,360.09	2,732.59
1865	525.96	1,669.70	224.06	1881	113.46	4,373.55	3,375.19
1866	63.78	1,733.48	469.71	1882	2.00	4,375.55	3,821.40
1868	115.37	1,848.85	469.71	1885	83.30	3,558.85	5,061.72
1869	6.58	1,855.43	581.22	1889	3.00	3,561.85	6,238.22
1870	168.11	2,023.54	634.61	1893	2.28	3,564.13	6,837.22
1871	805.70	2,829.24	682.19				

In 1900 a decree defining the rights of ten reservoirs was handed down. The capacity of each of these is given, the total being 174,056,228 cubic feet per second, the dates running from 1869 to 1893.

Nine years after the adjudication certain ditches brought suit against other ditches in the district in an attempt to have their decrees cut down. It was alleged that the latter had never, up to the time of the decree, used any such amounts of water as were awarded them, but afterwards their capacities were enlarged and the area increased and the excess decreed put to use. The supreme court held that the decree was res adjudicata, nine years having elapsed. "One of the things determined and settled by the decree is the quantity of water to which the parties thereto are entitled."[a] No suits have been brought to close the ditches in this district for the benefit of those below. The early rights prior to any in the lower district are sufficient to absorb the ordinary flow of the stream.

District 5.—District 5 comprises the drainage area of St. Vrain Creek and its tributaries except Boulder and Coal creeks, which are in district 6. This district can receive water from no other source than St. Vrain Creek and its tributaries, and the water from St. Vrain can be used in districts 2, 1, and 64.

The decree defining rights in this district was rendered in 1882. In estimating the appropriations the referee found the areas actually irrigated by the ditches and the number of inches of water required. The duty of water, as estimated by the referee, varied from 1 cubic foot per second for 4 acres to 1 cubic foot per second for 48 acres. As a result of this method of computing rights many of the ditches were awarded more water than they could carry. The decree made the award in the terms of "customary inches." These inches were not defined, but they have since been reduced to cubic feet per second

[a] Boulder and Weld Ditch Co. *v.* Boulder Ditch Co., 22 Colo., 115.

on the basis of the legal Colorado inch—38.4 inches equaling 1 cubic foot per second.

The following table gives the amounts decreed and the sum of prior rights in lower districts:

Rights to water in district 5 and prior rights in lower districts.

Year.	Rights in district 5.		Prior rights in lower districts.	Year.	Rights in district 5.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
1860	47.31	47.31		1872	163.68	2,263.90	1,133.41
1861	85.60	132.91		1873	163.73	2,427.63	1,250.57
1862	158.14	291.05	29.77	1874	207.77	2,635.40	1,793.07
1863	167.90	458.95	77.65	1875	21.71	2,657.11	1,979.57
1864	119.46	578.41	167.21	1876	1.44	2,658.55	2,352.21
1865	227.08	805.49	224.06	1877	12.55	2,671.10	2,584.28
1866	126.23	931.72	469.71	1878	122.19	2,793.29	2,708.96
1867	34.31	966.03	469.71	1879	50.27	2,843.56	2,732.59
1868	12.79	978.82	469.71	1880	16.14	2,859.70	3,277.69
1869	48.89	1,027.71	581.22	1881	3.77	2,873.47	3,375.19
1870	815.52	1,843.23	634.61	1884	9.11	2,872.58	4,961.72
1871	257.04	2,100.27	682.19				

Nine reservoirs have decreed rights amounting to 346,755,061 cubic feet.

District 4.—District 4 comprises the drainage area of Big Thompson River and its tributaries. Water can be secured from no other stream, but the water of Big Thompson can be used in the lower end of district 2 and in districts 1 and 64. The decree for this district was rendered in 1883. Some of the rights are based upon the acreages said to be irrigated, as in district 5, while others are based upon the capacities of the ditches. In speaking of the capacities of the ditches in this district the referee said: "I find the capacity of the ditch by taking an average of the estimates."

The following table gives the rights in district 4 and the prior rights in the lower districts:

Rights to water in district 4 and prior rights in lower districts.

Year.	Rights in district 4.		Prior rights in lower districts.	Year.	Rights in district 4.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1861	99.62	99.62		1873	250.43	868.85	1,250.59
1863	37.14	136.76	77.65	1874	19.06	887.91	1,793.07
1864	42.73	179.49	167.21	1875	143.41	1,031.32	1,979.57
1865	139.92	319.41	224.06	1876	103.81	1,135.13	2,352.21
1866	74.45	393.86	469.71	1877	209.42	1,344.55	2,584.28
1867	97.03	490.89	581.22	1878	235.51	1,580.06	2,708.96
1868	3.77	494.66	581.22	1879	6.22	1,586.28	2,732.59
1869	31.51	526.17	581.22	1880	191.53	1,777.81	3,277.69
1870	39.04	565.21	634.61	1881	626.44	2,404.25	3,375.19
1871	40.00	605.21	682.19	1883	123.48	2,527.73	4,811.72
1872	13.21	618.42	1,133.41	1884	8.83	2,536.56	4,961.72

There are a large number of reservoirs in this district, six of which have decreed rights amounting to 680,478,665 cubic feet.

A suit was brought by the Lower Latham ditch in district 2 to have certain ditches in district 4, with later rights than its own, closed, and the water officials have been ordered to close these ditches when the supply is not sufficient to supply the Lower Latham ditch.

District 2.—District 2 includes the South Platte and its tributaries on the east side from the mouth of Cherry Creek to the mouth of the Cache la Poudre. It can receive water from districts 23 and 8 on the main river and from the streams in districts 9, 7, 6, 5, and 4 on the west side of the river. Rights in this district are subject to prior rights in districts 1 and 64. The decree was rendered in this district in 1883. Each ditch was decreed the amount of water which the referee found to be its full carrying capacity. The dimensions and grades of the various ditches were stated by the parties themselves, no engineer being employed, the capacities being computed from these estimates by the referee. Although no statements of the areas irrigated were made by the referee, he stated in his findings that "no more water was appropriated than is necessary for the irrigation of the lands under the ditch." The decree itself, however, does not contain this statement.

The following table gives the rights in district 2 and the prior rights in the lower ditches:

Rights to water in district 2 and prior rights in lower districts.

Year.	Rights in district 2.		Prior rights in lower districts.	Year.	Rights in district 2.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1860	29.77	29.77		1873	281.48	1,388.07	144.00
1862	47.88	77.65		1874	159.50	1,547.57	405.00
1863	89.56	167.21		1875	314.14	1,861.71	452.00
1864	56.85	224.06		1876	205.07	2,066.78	490.50
1865	245.65	469.71		1877	224.68	2,291.46	490.50
1866	111.51	581.22		1878	23.63	2,315.09	490.50
1869	38.39	619.61		1879	545.10	2,860.19	490.50
1870	47.58	667.19	15.00	1881	281.21	3,141.40	615.00
1871	427.22	1,094.41	15.00	1882	339.42	3,480.82	780.00
1872	12.18	1,106.59	39.00	1885	350.00	3,830.82	1,580.90

Two reservoirs in this district have decreed rights, but the quantity of water to which they are entitled is not given in the decree. Ditch owners in this district have had considerable litigation in attempting to have water turned down to them from other districts. As was previously noted, suits against ditches in district 7 were unsuccessful, while one against ditches in district 4 was successful. Ditches in districts 8 and 9 are also closed at times. As shown by the preceding table, rights in district 2 are principally prior to rights in districts 1 and 64, so that it is seldom necessary to turn water down to these districts.

District 3.—District 3 comprises the drainage area of Cache la Poudre River and tributaries. Some water has been diverted into this district from tributaries of the North Platte and the Grand. Aside from this the district receives no water from outside its own limits. The water not used in district 3 can be used in districts 1 and 64. The decree which governs rights in this district was rendered in 1882. Rights were decreed on the basis of the capacities of the ditches, these capacities being computed from the dimensions of the ditches as testified to by their owners. The rights thus decreed were largely in excess of the quantities which had been used or which could be carried by the ditches; especially is this true of the rights of the small early ditches. The large ditches with late priorities received amounts approximating their actual capacities. Some of these rights have been attacked on the ground that the ditches could not carry the volumes of water decreed. In one such case the supreme court of the State held "if a mistake was made by the court in computing the capacity of the ditch, such a mistake can not be corrected in this proceeding; the capacity is res adjudicata as much as any other fact which the special statute requires the court to determine."[a] Under this decision the excessive rights are vested even if the ditches have never used the volume of water decreed and can not carry it. They can be lost only by abandonment.

The following table gives the rights in district 3 and the prior rights in lower districts:

Rights to water in district 3 and prior rights in lower districts.

Year.	Rights in district 3.		Prior rights in lower districts.	Year	Rights in district 3.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1860	24.80	24.80		1872	317.95	1,794.36	39.00
1861	24.08	48.88		1873	440.86	2,235.22	144.00
1862	127.20	176.08		1874	229.87	2,465.09	405.00
1863	8.70	184.78		1875	88.52	2,553.61	432.00
1864	78.40	263.18		1876	13.44	2,567.05	490.50
1865	39.63	302.81		1877	126.85	2,693.90	490.50
1866	82.47	385.28		1878	611.06	3,304.96	490.50
1867	169.51	554.79		1879	287.11	3,592.97	490.50
1868	55.30	610.09		1880	173.67	3,765.74	517.50
1869	65.92	676.01		1881	532.42	4,298.16	615.00
1870	191.25	867.26	15.00	1882	83.97	4,382.13	780.00
1871	609.15	1,476.41	15.00	1884	315.00	4,647.13	1,580.90

There is a large number of reservoirs in this district, but their rights had not been defined in 1904. Testimony regarding the capacities and dates of construction of these reservoirs was taken during the summer of 1904 preparatory to an adjudication. The rights in this district, which are prior to any in the lower districts, are

[a] Water Supply and Storage Company *v.* Larimer and Weld Company, 24 Colo., 323.

sufficient to use the entire flow of the river during seasons of low water when shortage would occur in the lower districts.

District 1.—District 1 comprises the lands watered by the South Platte and its tributaries between the mouth of Cache la Poudre and the west line of Washington County. The district can receive water from all the districts above on the main stream and the tributaries and is obliged to supply water to district 64 below. The rights in this district are in general later than those in the districts above, so that it can demand little water from them. The decree defining the rights in this district was rendered in 1895. The standard by which the rights were measured was the amount of water actually used. The referee found that each ditch, with four exceptions, had used water to its full capacity. The four ditches excepted were held not to have used water to their full capacities, and were decreed less than these amounts.

The following table gives the rights in district 1 and the prior rights in lower districts:

Rights to water in district 1 and prior rights in the lower district.

Year.	Rights in district 1.		Prior rights in lower district.	Year.	Rights in district 1.		Prior rights in lower district.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1869	15.00	15.00	----------	1881	165.00	310.00	470.00
1871	24.00	39.00	----------	1882	461.00	771.00	470.00
1872	15.00	54.00	----------	1884	60.00	831.00	809.90
1873	8.00	62.00	90.00	1886	99.00	930.00	889.90
1874	25.00	87.00	343.00	1887	20.00	950.00	932.40
1875	21.00	108.00	345.00	1888	625.00	1,575.00	932.40
1876	27.00	135.00	382.50	1889	71.00	1,646.00	932.40
1880	10.00	145.00	382.50				

Six reservoirs in this district supplied from torrential tributaries of the South Platte have decreed rights. There are a few reservoirs, built since the decree was rendered or now under construction, rights for which are undefined. Some of the large ditches in this district have rights later than those in district 64, and are closed by the water commissioner on order of the division engineer when water is scarce.

District 64.—District 64 comprises all the lands watered by the South Platte River and its tributaries between the western boundary of Washington County and the Colorado-Nebraska State line. Five adjudications of water rights have taken place in this district. In the first adjudication, in 1894, the court found that 1 cubic foot of water per second is needed for the irrigation of every 50 acres of land, and that in addition there is lost by seepage and evaporation 25 per cent of the volume used. The decree awards water to the

ditches according to this rule. The second adjudication took place in 1896. Three ditches were awarded amounts equaling their claimed capacities. The last three decrees in district 64 were rendered in 1897, 1898, and 1903. Several ditch owners whose rights were not included in any of these decrees have petitioned for a hearing and a determination of their rights. In these adjudications each ditch was awarded 1 cubic foot per second for every 50 acres found to be irrigated by it, with no additional allowance for seepage or evaporation. This district, being the lowest on the river in Colorado, can receive water from all the districts above, and so far has not been required to turn water down to ditches in Nebraska.

The following table shows the rights decreed in this district:

Rights to water in district 64.

Year.	Rights in district 64.		Year.	Rights in district 64.	
	Rights acquired.	Sum to date.		Rights acquired.	Sum to date.
	Cubic feet per second.	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*
1872	90.00	90.00	1890	8.00	935.40
1873	253.00	343.00	1892	25.00	960.40
1874	2.00	345.00	1893	85.00	1,045.40
1875	37.50	382.50	1894	42.00	1,087.40
1880	87.50	470.00	1895	490.00	1,577.40
1882	189.90	659.90	1896	50.00	1,627.40
1883	150.00	809.90	1897	50.00	1,677.40
1884	60.00	869.90	1898	60.00	1,737.40
1886	62.50	932.40			

There are in this district several large ditches recently built which have no decreed rights, but proceedings for defining their rights were begun in 1904. It is reported that plans for the construction of at least one large reservoir have been completed.

NEBRASKA.

The South Platte River in Nebraska is in Division 1–A. The rights along this section of the stream have not been finally decided by the State board of irrigation or by the courts. An adjudication was held at which rights to irrigate 5,200 acres, dated 1894, were conditionally granted, and rights to irrigate 2,040 acres, dated 1895, were also conditionally granted. The supreme court has recently held that the board of control had no power to place conditions on rights initiated prior to the enactment of the law of 1895. Under this decision these rights, as determined by the board, are vested, and can be lost only by abandonment, which requires ten years' nonuse.[a] On the basis of the maximum volume of water allowed in Nebraska—1 cubic foot per second for 70 acres—this gives rights to 82.86 cubic feet per second, dated 1894, and 29.14 cubic feet per second, dated

[a] Farmers' Irrig. Dist. *v.* Frank, 100 N. W., 286.

1895. In addition to these, applications have been approved by the board as follows:

Applications approved for the diversion of water from the South Platte River in Nebraska.

Date.	Area.	Volume.
	Acres.	*Cubic feet per second.*
1895	1,400	20.00
1896	11,895	169.93
1897	15,540	222.00
1898	440	6.29
Total	29,275	418.22

Final proof has not yet been made on the rights for which the above permits were issued; hence it can not be stated what rights actually exist here.

These are the only rights on the South Platte in Nebraska acquired by appropriation. Under the doctrine announced in Crawford Company *v.* Hathaway (see p. 85), riparian lands in the State acquired from the Government prior to 1889 have rights to a reasonable use of water for irrigation dating from the time of their acquirement from the Government. The lands along the stream, with the exception of very small tracts, were acquired from the Government before 1894, the date of the earliest right in Nebraska acquired by appropriation. The date of the first acquirement of any lands from the Government in the vicinity of the junction of the North and South Platte rivers was 1871. The railroad lands between the junction of the rivers and the west line of range 32 west, in the neighborhood of the town of Hershey, were selected in 1874. West of that private lands were acquired from the Government mostly after 1883, while the railroad lands in the four townships next west were selected in 1890 after the passage of the irrigation law which the Nebraska court has held abrogated riparian rights, and therefore have no such rights. Private lands in this section were mostly taken up later than 1883. The railroad lands in ranges 37, 38, 39, 40, and 41 were selected in 1886. Private lands in these ranges were taken after 1883. In range 42, immediately below the Colorado-Nebraska line, railroad lands were selected in 1892, and therefore have no riparian rights. Private lands in this section were acquired between 1883 and the present time.

Under the decision in Crawford Company *v.* Hathaway it is held that riparian rights extend only to the land acquired from the Government under a single patent, and that in case of railroad lands it does not extend to the entire section, but only to the subdivisions usually disposed of by the Government. The South Platte River is a meandered stream, and most of the riparian lands were disposed of

in lots rather than in even fractions of a section. As a rule, therefore, riparian rights extend to small areas only. The right of the riparian owner is to a reasonable use of water for irrigation, taking into consideration a like reasonable use by all other riparian owners. It is therefore impossible to make any statement of the volume of water to which these riparian lands are entitled. Under the common-law doctrine the right of a riparian proprietor certainly goes no further than to have the stream continue to flow "as it was wont to flow." The flow of the stream in this section from the earliest exploration of this region has been extremely uncertain, the stream going dry in many years and being extremely low in parts of almost every year. (See p. 46.) It is therefore very doubtful whether these riparian proprietors could secure any damages due to shortage of water, since the ditch owners could probably prove that during the season when there is a scarcity of water the river was wont to run dry.

The following table brings together all the decreed rights to water from South Platte River and tributaries, by years:

Rights to water from South Platte River and tributaries.

Year.	Colorado.		Nebraska.		Total.
	Rights acquired.	Sum to date.	Rights acquired.	Sum to date.	Sum to date.
	Cubic feet per sec.	*Cubic feet per sec.*	*Cubic feet per sec.*	*Cubic feet per sec.*	*Cubic feet per sec.*
1859	128.43	128.43			128.43
1860	389.86	518.29			518.29
1861	533.85	1,052.14			1,052.14
1862	755.28	1,807.42			1,807.42
1863	765.46	2,572.88			2,572.88
1864	606.94	3,178.82			3,178.82
1865	1,422.79	4,601.61			4,601.61
1866	514.70	5,116.31			5,116.31
1867	481.82	5,598.13			5,598.13
1868	285.90	5,884.03			5,884.03
1869	245.31	6,129.34			6,129.34
1870	1,190.99	7,320.33			7,320.33
1871	1,736.47	9,056.80			9,056.80
1872	999.90	10,056.70			10,056.70
1873	2,031.83	12,088.53			12,088.53
1874	937.96	13,026.49			13,026.49
1875	1,048.68	14,075.17			14,075.17
1876	731.47	14,806.64			14,806.64
1877	698.65	15,505.29			15,505.29
1878	1,619.09	17,124.38			17,124.38
1879	2,493.66	19,681.04			19,681.04
1880	629.19	20,247.23			20,247.23
1881	2,171.40	22,418.63			22,418.63
1882	1,591.72	24,010.35			24,010.35
1883	377.21	24,387.56			24,387.56
1884	693.65	25,081.21			25,081.21
1885	619.78	25,700.99			25,700.99
1886	318.71	26,019.70			26,019.70
1887	183.87	26,203.57			26,203.57
1888	1,304.29	27,507.86			27,507.86
1889	126.60	27,633.46			27,633.46
1890	33.00	27,666.46			27,666.46
1891	35.00	27,701.46			27,701.46
1892	25.00	27,726.46			27,726.46
1893	102.28	27,828.74			27,828.74
1894	42.00	27,870.74	82.86	82.86	27,953.60
1895	825.86	28,696.60	49.14	132.00	28,801.39
1896	50.00	28,746.60	169.98	301.98	29,933.32
1897	50.00	28,796.60	222.00	523.98	30,007.25
1898	60.00	28,856.60	6.29	530.22	30,597.47

As shown by the tables given, there is a stream discharge of 2,765 cubic feet per second, and established rights to this supply amounting to 30,597.47 cubic feet per second, or more than ten times the total supply as measured above the heads of the ditches.

QUESTIONS BETWEEN THE STATES.

Comparing the rights in Colorado and Nebraska on the supposition that the State line has no effect upon the rights to water, but that all rights on the stream are subject to prior rights, we find the following conditions:

The earliest rights on the South Platte in Nebraska are the riparian rights attached to the lands in the vicinity of the junction of the North and South Platte rivers, acquired from the Government in 1871. Under the decisions of the Colorado courts, rights to 7,320.33 cubic feet per second were acquired prior to 1871. Alternate sections of the land in this vicinity were granted to the Union Pacific Railroad Company. These were selected in 1874, prior to which date there had been acquired in Colorado rights to 12,088.53 cubic feet per second. Settlement as early as 1871 extended only a short distance west of North Platte. Beyond this, as far as the Colorado line, riparian lands acquired from the Government by private parties were entered from 1883 up to the present time. Prior to 1883 rights to 24,010.35 cubic feet per second had been acquired in Colorado. The railroad lands from the vicinity of the town of Hershey to the town of Korty were selected in 1890 and have no riparian rights. From the town of Korty west almost to the State line railroad lands were selected in 1886. Prior to their selection rights to 25,700.99 cubic feet per second had been acquired in Colorado. The earliest right to water from the South Platte in Nebraska acquired by appropriation is 1894. Prior to this, rights to 27,828.74 cubic feet per second from the South Platte and tributaries had been acquired in Colorado.

From the above statement it is seen that before any rights were acquired in Nebraska, either by appropriation or by the purchase of riparian lands from the Government, rights to more than 7,300 cubic feet per second of water from the South Platte River and its tributaries had been acquired in Colorado. This is more water than the stream supplies, except in flood season, when there is plenty of water in the river, both in Colorado and Nebraska, for all existing rights. However, it is a well-known fact that a large part of the rights decreed to ditches built earlier than 1870 in Colorado are in excess of their carrying capacities, and this does not fairly represent the volume which can be used by canals on their priorities earlier than 1870.

The largest appropriations in the South Platte Valley in Colorado were made in the years from 1870 to 1882. All of the rights attaching to these ditches are prior to the acquirement of riparian lands either by private parties or the Union Pacific Railroad, except in the immediate vicinity of North Platte. The general conclusion as to rights on the South Platte must therefore be that both under the doctrine of prior appropriation and under the doctrine of riparian rights, as stated by the supreme court of Nebraska, Colorado ditch owners have the earlier rights.

As to the relation of rights acquired by appropriation in Colorado to riparian rights in Nebraska, even if the supreme court of Nebraska had not held that lands acquired from the Government since 1889 had no riparian rights and that as between riparian rights and those acquired by appropriation the date of acquirement should govern, rights by appropriation in Colorado would probably be held to be superior to riparian rights of lands acquired from the Government since the acquirement of the rights in Colorado. The law of Congress of 1866 provides "that whenever by priority of possession rights to the use of water for mining, agricultural, manufacturing, or other purposes have vested and accrued and the same are recognized and acknowledged by the local customs, laws, and decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same." The rights in Colorado were acquired in accordance with local customs and laws, and would seem to be good as against the rights attached to lands acquired subsequently, whether these lands are in a State where the same customs and laws are enforced or outside of it.

Although there are sufficient rights in Colorado prior to any in Nebraska to exhaust the ordinary flow of the South Platte, there is sufficient return seepage from the river to provide, in some seasons of the year, a considerable flow in the vicinity of the State line (see p. 48). In district 64 in Colorado, which is immediately above the State line, several ditches have been constructed recently and are constantly enlarging their use of the water as more land is reclaimed. The rights of some of these ditches are subsequent to both riparian rights and those acquired by appropriation in Nebraska, and controversy may arise between the owners of the ditches in district 64 and those in Nebraska.

It has been shown in the preceding pages that the rights decreed in Colorado are in many cases largely in excess of the quantities which have been used by the ditches. Mr. Adams estimates the amount decreed to the 109 ditches for which he kept records, in excess of their carrying capacities, at 4,164 cubic feet per second, or more than 30 per

cent of the total amount decreed them. These were, however, the larger ditches. The smaller ditches received decrees even more in excess of their capacities. This estimate is based on the capacities of the ditches, not on the volume of water which has been put to a beneficial use. The excess is, therefore, larger than that given. However, only a few of the large ditches in Colorado have rights to more water than they can carry, or more than is used under them when it can be secured, and few of them receive their full decreed amount during times of low water. The rights of most of the large ditches are prior to any rights acquired by appropriation in Nebraska. Therefore, the cutting down of the rights of the Colorado ditches to the amounts actually used by them would be of no benefit to Nebraska ditches, since the water taken from the early ditches would go to supply ditches in Colorado, which, although later than the ditches which would be cut down, are still prior to the ditches in Nebraska.

What is true as to excessive rights in Colorado is equally true as to rights in Nebraska. The State board of irrigation of Nebraska held an adjudication on the South Platte and allowed rights to large areas which were not yet irrigated, on condition that the canals be constructed and the water applied to the land. In the case of The Farmers' Irrigation District *v.* Frank[a] the supreme court of Nebraska held that in a similar case on the North Platte the State board of irrigation had no authority to grant rights, but was limited to defining rights as they existed at the time of the adjudication; that therefore the conditions prescribed by the board would not hold and the ditch owners had absolute rights to the volumes allotted to them by the board, which rights could be lost only by abandonment, which required ten years' nonuse. Under this decision the situation in Nebraska is even worse than that in Colorado. In Colorado there was at least a claim that the water had been used or that ditches had been built, while in Nebraska no such claim was made, but the use was almost entirely prospective. Had the board known that it was not empowered to fix these conditions probably it would have defined the rights on the basis of what had been used rather than on the prospective use, but the decision of the supreme court puts on the decree of the board a meaning which was never intended and which contains no element of justice to other appropriators from the stream. The court states that the board could not grant a right, while the effect of the decisions is that the board did grant a right. We have, then, in the two States conditions as to excessive rights differing only in degree. In Colorado the courts in determining rights

[a] 100 N. W., 286.

decreed to many of the ditches more water than they had ever used or could carry. These decrees not being appealed from within the statutory period, the rights are held to be vested and can be lost only by abandonment. Other ditches have used the water belonging to the first ditches under these decrees, but not used by them; but the first ditches have been enlarged to use their surplus, or the excess over their need or capacities has been sold, thereby taking water away from those who had been using it perhaps for years. The excessive rights are therefore a menace to all later rights. In Nebraska the board conditionally allowed rights for lands yet to be reclaimed, and the supreme court has removed the conditions, so that the rights have vested without the performance of the conditions and can be lost only by abandonment. This leaves all later rights liable to suffer from enlarged use under these excessive rights, and hence discourages development by making the title to the water uncertain pending the expiration of the statutory period for the loss of the excessive rights by abandonment. Fortunately this applies only to rights initiated before 1895 and adjudicated by the State board of irrigation. As these adjudications were held nearly ten years ago and little has been done toward putting to use the water allotted, the time will soon come when these rights can be declared abandoned if proper actions are brought.

The excessive rights in both States are a menace to all later rights in either State, but it seems that decrees of each State allowing them must be recognized by the other State until the rights are lost by abandonment.*

EFFECT OF PHYSICAL CONDITIONS.

So far the rights to South Platte River have been discussed as if there was a fixed supply of water, which, if not taken by one ditch, would remain in the stream to be taken by others, and which, if taken by one ditch, was entirely consumed and not available for others. This, however, is not the case. If it were true, only a few of the earliest ditches could be supplied by the Platte River and its tributaries.

To illustrate this: During the latter part of August, 1903, measure-

*A judgment of a court of a sister State, authenticated as prescribed by act of Congress, is conclusive here upon the subject-matter of the suit. An action thereon can only be defeated on the ground that the court had no jurisdiction of the case and there was fraud in procuring the judgment, or by defenses based on matters arising after the judgment was rendered. (Snyder *v.* Critchfield, 44 Nebr., 66.)

ments of the flow of the stream and the diversions in district 8 were made. The flow where the river enters this district was 91.85 cubic feet per second. The flow at Denver, where the river leaves the district, was 46.36 cubic feet per second, while the diversion between the two points amounted to 134.53 cubic feet per second, showing that there was diverted almost 50 per cent more water than was flowing past the gauging station, while there remained in the stream at the lower end of the district half as much water as there was entering at the head of the district.

Distributing water in accordance with the rights is not, therefore, a simple division of a fixed quantity of water, in accordance with a definite table of priorities. In order that rights to a certain volume in the lower districts be supplied it is not always necessary to allow this volume to flow down from the upper districts, but it may be supplied to the stream by seepage. Again, there are sections of the river where water, if turned down for lower ditches, would be lost by sinking in the sand or by evaporation, so that it could not reach the heads of the lower ditches. So long as a water-right holder secures his proper supply of water it is a matter of indifference to him what is done above him on the stream. Physical conditions, therefore, have a great deal to do with the relations of rights.

The right of the riparian proprietor is not to enough water to irrigate his riparian land, but to a reasonable use of what water flowed naturally to his land. This raises the question as to what water naturally flowed in the South Platte River at the time these riparian lands were acquired, and as to what influence irrigation above has had on any changes which may have taken place in the flow of the stream since that time. To determine this, in the absence of the records of the flow of the stream in early years, it has been necessary to collect the testimony of settlers and travelers as to early conditions and to make measurements to determine the present effect of diversions on the upper sections of the stream upon the flow of the stream in the lower section. Such measurements have been carried on for a number of years by the Colorado Agricultural College and Experiment Station, and by the State engineer's office of Colorado, and during the season of 1903 a series of similar measurements was made by Mr. C. E. Tait, of this Office, and Prof. O. V. P. Stout, of the University of Nebraska. The testimony as to the early conditions on the river and the measurements of return seepage are brought together in the following pages.

The published reports of early travels and explorations along the South Platte River give little definite information as to its flow.

Long's expedition crossed the South Platte June 20, 1820. He described the Platte River as follows: "It is about 9,000 yards wide

and very rapid, but so shoal that we found it unnecessary to dismount from our horses or unpack our mules."[a] As this was in June, the river should have been in flood.

Thomas J. Farnham in his Travels in the Great Western Prairies, etc., London, 1843, speaking of the Platte, says: "This river is not navigable for steamboats at any season of the year. In the spring floods the bateaux of the American fur traders descend it from the forts on its forks. But even this is so hazardous that they are beginning to take down their furs in wagons. * * * During the summer and autumn months the waters are too shoal to float a canoe." (Page 106.)

Fremont's expedition went up the South Platte in July, 1842. He states that the stream was not navigable for anything drawing 6 inches of water.

Edwin Bryant, in What I Saw in California,[b] states that he met a fur trader who had started down the Platte with furs and was obliged to leave his boats on account of the low water June 11, 1849.

Stansbury's expedition crossed the South Platte a short distance above North Platte June 28, 1849. He states that the river was easily crossed in low water. (Page 272.)

None of these early explorers speak of the river as being dry, yet all seem to agree that it got very low, in the summer at least. As Fremont says: "It is not navigable for anything drawing 6 inches of water."

There are yet living in the basin of the Platte a great many people who went to that section before irrigation began. Statements as to the condition of the river have been secured from a number of those early settlers.

W. R. Bryant, of Cheyenne, Wyo., says that he "was along the Platte River in Nebraska and Colorado during the sixties in every year until 1870. He never saw the Platte dry but once; that was in the fall of 1864, for a distance of about 75 miles below the Colorado line. In that season water could be found anywhere in the bed of the Platte by digging 2 or 3 feet into the sand."

H. B. Kelley, of Cheyenne, Wyo., said that the Platte occasionally ran dry in the neighborhood of Julesburg. He remembered one or two occasions when it was so, but could not give the dates. He is of the opinion that in both branches of the Platte there was more water in the early days than now, and suggested as a possible reason for this the removal of the timber on the headwaters.

Maj. John Talbot, of Cheyenne, Wyo., stated that he came to Fort Laramie, Wyo., in 1854; he said that the South Platte never ran dry

[a] Long's First Expedition, vol. 1, p. 467. Philadelphia, 1823.

[b] D. Appleton & Co., New York, 1849, p. 83.

above the forks until about 1875, and once about 1864 or 1865 it ran dry at Fort Kearney.

John J. Brewer, of Irondale, Colo., stated that he came to Colorado in 1861. He said that he remembers well hearing the freighters who came along the South Platte say that down toward the Colorado line the river sank into the sand and they were obliged to dig holes to water their horses. He was of the opinion that this was in the years before 1870.

John Lillie, of Littleton, Colo., stated that the South Platte was dry in 1863 from a point 10 miles below Denver for 200 or 300 miles anyway, and he did not know how much farther. In some seasons there used to be some water in the South Platte in the neighborhood of the State line, and in other seasons it ran dry and disappeared in the sand for long stages.

Judge Ames, of Littleton, Colo., says that he came to Colorado in 1860. The season of 1863 was unusually dry. Water flowed down the river only a short distance below Denver. He remembered that in that year in particular the freighters told of having to dig holes in the sand in order to get water for animals.

Ed. Montgomery, of Littleton, Colo., says that he came West in 1860. In the summers of 1862–1864 he was freighting along the river and found plenty of water. However, in 1863 the river went dry and it was necessary to dig holes to secure water.

C. C. Hawley, of Fort Collins, Colo., says that he came West in 1860. He went along the South Platte River in the summer of 1863 and from a short distance below the mouth of the Poudre all the way down beyond to the State line the river was entirely dry and they were obliged to dig for water. He went down the South Platte to Julesburg late in the summer of 1864 in connection with the Indian troubles, as he was in the Army. The river was then completely dry, as before, there being only now and then a hole with a little water in it.

Mr. Hawley understands from the oldtimers that, as a usual thing, the South Platte went dry every summer from below the mouth of the Poudre for a distance of 200 miles, very nearly to the junction of the North and South forks.

Bruce Johnson, of Greeley, Colo., came out in 1859. He went up and down the South Platte two different years during the sixties, but did not remember which years. Both of these years the river was dry from Julesburg to the junction, and in one of these years—he thought it was in 1864—the river was dry from the junction to Fort Kearney, and farther down for all he knew. The river in the years mentioned was completely dry.

Hon. Eugene F. Ware, formerly Commissioner of Pensions, Topeka, Kans., who was with the United States troops along the Platte River

in the sixties, stated that in 1865 he saw the buffalo pawing in the bed of the Platte to obtain water.

J. J. Armstrong, of Denver, Colo., says that he came to Colorado in 1870. That in the early days, from Platteville down, the South Platte River was practically dry in August and September, except for a few small channels. In 1873 he rode from near Platteville or Greeley along the bed of the river, which was nothing but sand bars with a few small, trickling channels.

Mr. Ryan, conductor on the Burlington Railroad between Nebraska City and Lincoln, Nebr., was freighting along the Platte River from 1860 to 1865. He stated that in 1863 the river was dry west of Julesburg for 100 miles.

John Bratt, of North Platte, Nebr., says that he thinks the South Platte went dry in the sixties, the same as it does now. In the early seventies he bought land along the South Platte; since that time the river has usually gone dry at times in summer, usually in August, but in the early summer there was more water then than now.

Charles McDonald, of North Platte, Nebr., was along the South Platte in the sixties. He says that the river went dry in 1862, and also in 1871.

Hon. John Evans, of North Platte, Nebr., says that he has been living in North Platte since 1871; that in early times the river went dry in exceptional years. Since 1895 it has gone dry every year.

W. A. Paxton, of Omaha, Nebr., who has had cattle ranches on the Platte since the early sixties, states that the river went dry in 1863, 1866, and 1871, and that it has gone dry every year since about 1885 or 1886.

Henry T. Clarke, of Omaha, Nebr., built several bridges across the Platte River in 1874. He states that in that year the river was dry, and it was necessary to dig holes in the river bed to secure water for his cattle.

Summing up these statements, the accounts of the early travelers and explorers, while not stating that the river was dry, all agree as to its being very low in summer. The testimony of the parties living in the Platte Valley show that the river was dry in places, and for short periods at least, during the years 1863, 1864, 1865, 1866, 1871, 1873, 1874, and 1875. For these years we have definite statements. For the years 1863 and 1864 we have a large number of statements that the river was dry. In addition to these definite statements as to particular years, we have the statement of J. J. Armstrong that it usually went practically dry; the statement of John Brewer that he heard freighters say that the water sank into the sand and that they were obliged to dig for water. Mr. Hawley states that he understood from the talk of oldtimers that as a usual thing the South Platte went dry below the mouth of the Cache la Poudre nearly to the junc-

tion of the North and South Platte rivers. Mr. John Bratt, of North Platte, states that it was his opinion that it went dry in the sixties as now. It seems, from these statements, that there can be no question that from the time of the earliest travelers the river has gone dry during the summer, in some years at least, and that it has always been very low in the late summer, and that in the summers of 1862 to 1866, before there were enough diversions in Colorado to have any effect upon the flow of the stream, the river went dry. In the early seventies, before the construction of most of the large canals in Colorado, there was another series of years when the river was dry. Since the building of the large canals in Colorado and the irrigation of large areas of land—that is, since 1885 and 1886—the river is said to have gone dry practically every year.

The fact that there never have been and are not now any irrigating ditches of any considerable size along the section of the river immediately above the State line and between that point and the junction of the branches of the Platte would also point to the conclusion that there never has been any reliable supply of water in this section of the South Platte River.

As has been stated before, the ownership of riparian land gives its owner no more than a right to have the river continue to flow as it was wont to flow. The above testimony shows conclusively that in the section of the river from the State line to the junction there never has been a reliable flow; that the river has gone dry in many years and has been extremely low every year. Under the doctrine announced by the Nebraska supreme court in Crawford *v.* Hathaway the riparian proprietor is not entitled to enjoin diversions for irrigation, but merely to damages resulting from the diversion of water by later appropriators. With the records showing that the river went dry in many years before irrigation began, it will be practically impossible for a riparian proprietor along this section of the river to prove that any damage which he may suffer from shortage of water is due to the diversion of the water above.

RETURN SEEPAGE.

It is contended by many people in Colorado and by some in Nebraska that irrigation on the stream in Colorado not only has not decreased the supply in Nebraska except during the spring flood, but has actually improved the condition of the river, or will do so in the future. The seepage measurements which are given below seem to show that an increase in the flow in the late summer is gradually progressing downstream and has already reached the State line.

Measurements have been made in the fall of every year since 1889, with the exception of 1897, to determine the amount of water returning to the river in the form of seepage. The results of these meas-

urements, with the exception of those made in 1903, as brought together in the following table, are taken from the reports of State engineers of Colorado. The measurements in 1903 were made by Mr. C. E. Tait, of this Office. (See map, Pl. I.)

Gain in flow of South Platte River from return seepage.

Section.	Distance.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
	Miles.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec*
Platte Canyon to head of City ditch	5.25			27.57	25.32	18.41	49.23	20.21
Head of City ditch to Littleton	6.25	49.91	11.73	52.61	44.63	23.50	25.59	56.23
Littleton to Denver	10.50	1.00	43.88	16.20	59.61	41.27	118.92	117.80
Denver to Brighton	21.25	26.16	43.30	78.81	−13.39	69.73	84.30	13.89
Brighton to Platteville	16.00	56.31	78.00	51.74	64.37	65.91	65.01	134.44
Platteville to Evans	17.00	63.62		72.28	12.32	61.11	107.46	44.28
Evans to Putnam ditch	27.50		156.69	119.50	137.75	85.85	98.61	179.41
Putnam ditch to Fort Morgan	27.50	188.58	50.58	51.80		113.89	158.52	234.11
Fort Morgan to Snyder	11.50							14.82
Snyder to Merino	18.00		21.53	79.73		34.72	58.67	145.26
Merino to Sterling	14.50	32.75	29.45	33.36		33.76		46.80
Sterling to Iliff	10.00	4.44	14.05	28.07		24.84	43.80	16.99
Iliff to Crook	15.00			−13.07				−48.05
Crook to Sedgwick	17.00			3.31			−34.17	−32.89
Sedgwick to State line	15.50							
Total	232.75	422.77	449.21	602.00	330.61	572.99	722.56	942.30

Section.	Distance.	1896.	1898.	1899.	1900.	1901.	1902.	1903.
	Miles.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
Platte Canyon to head of City ditch	5.25	10.18	1.21	72.98	33.96	21.22	5.04	31.64
Head of City ditch to Littleton	6.25	14.76	26.44	60.96	40.17	11.49	13.24	24.31
Littleton to Denver	10.50	33.95	61.63	16.40	16.22	35.63	24.90	12.56
Denver to Brighton	21.25	67.29	49.66	124.01	70.27	73.29	48.67	103.60
Brighton to Platteville	16.00	92.87	112.35	88.79	56.08	130.67	66.24	44.42
Platteville to Evans	17.00	37.59	110.97	111.50	117.10	138.84	95.17	85.56
Evans to Putnam ditch	27.50	87.99	160.13	150.38	79.14	182.24	92.23	139.77
Putnam ditch to Fort Morgan	27.50	90.61	94.62	97.74	99.79	90.89	117.28	85.27
Fort Morgan to Snyder	11.50	52.79	37.13	72.63	83.77	65.87	61.33	46.24
Snyder to Merino	18.00	66.21		93.87	85.54	97.04	80.35	34.76
Merino to Sterling	14.50	32.60		73.73	62.06	47.00	97.17	73.92
Sterling to Iliff	10.00	21.36		46.19	5.19	32.04	7.27	39.27
Iliff to Crook	15.00			69.38	23.64	12.12	29.83	4.61
Crook to Sedgwick	17.00			−17.13	−50.69	3.73	.10	1.71
Sedgwick to State line	15.50			41.23	77.98		10.67	1.97
Total	232.75	608.20	654.14	1,102.61	800.19	941.57	749.49	729.61

In 1903 measurements were carried on down the river in Nebraska so far as there was any visible flow in the stream. These measurements were made by Prof. O. V. P. Stout, of the University of Nebraska. The first section measured extended from the head of the Western Canal to Ogallala, 26.5 miles, and showed a loss of 74.86 cubic feet per second. The second section extended from Ogallala to Korty, a distance of 13 miles, and showed a loss of 7.71 cubic feet per second, making a total loss between the head of the Western Canal, which is very near the State line, and Korty, where the river was dry, of 82.57 cubic feet per second, or all the water in the stream.

The table given above shows that there is no uniformity in the gain in any section from year to year or in the stream as a whole. The amount of return seepage depends on so many factors which vary from year to year that it is not to be expected that there would be any

uniformity or any gradual increase or decrease in the seepage returns in any given section. The amount of water coming into the stream from the lands bordering it in any section must depend primarily upon the amount of water received by these lands, either in the form of rainfall or irrigation. The amount of rainfall varies from year to year without any fixed law, and the amount used in irrigation depends upon the amount which can be secured for that purpose. In general, then, larger returns will be expected in wet years than in dry years, since in such years the lands receive more water from both irrigation and rainfall.

The rate of flow of water through soils is extremely slow, and water applied to land at some distance from the stream takes several years to reach the stream, so that the entire effect of heavy irrigation may not be shown immediately in the return seepage. This would tend to decrease the variations in the return flow due to wet and dry seasons. It is therefore practically impossible to establish any relation between the quantity of water received by land and the amount of water which will be supplied by this land to the stream.

The measurements given in the table for each year were made by a party which started at the canyon and went down the stream, the supposition being that the rate of progress made by the party would be about the same as the velocity of the flow of the river. In this way any changes would be attributed to losses or gains in the channel of the stream rather than to the rising and falling of the stream as a whole. It is impossible to eliminate entirely the effects of increases and decreases in the flow of the stream as a whole, and to the extent to which such fluctuations occur the value of these measurements, as indexes of return seepage, is destroyed. Grouping these measurements into periods will help to minimize the effect of variations since these will tend to offset each other. The measurements given cover fourteen years. Dividing these into two seven-year periods gives the results which are shown in the following table:

Gain or loss in flow of South Platte River by seven-year periods.

Section.	Length.	Before 1896.		After 1895.	
		Total.	Per mile.	Total.	Per mile.
	Miles.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*
Platte Canyon to City ditch	5.25	28.15	5.36	25.17	4.79
City Ditch to Littleton	6.25	37.17	5.95	27.34	4.36
Littleton to Denver	10.50	56.95	5.42	28.76	2.74
Denver to Brighton	21.25	43.26	2.04	76.68	3.61
Brighton to Platteville	16.00	67.94	4.25	84.49	5.28
Platteville to Evans	17.00	57.82	3.37	99.53	5.85
Evans to Putnam ditch	27.50	119.90	4.36	127.41	4.63
Putnam Ditch to Fort Morgan	27.50	98.34	3.39	95.17	3.46
Fort Morgan to Snyder	11.50	25.12	2.18	59.97	5.21
Snyder to Merino	18.00	63.35	3.52	76.30	4.24
Merino to Sterling	14.50	32.03	2.21	64.41	4.44
Sterling to Iliff	10.00	16.58	1.66	25.22	2.52
Iliff to Crook	15.00	−14.83	− .99	27.92	1.86
Crook to State line	32.50	−21.25	− .65	13.91	.43

In some years the sections between measurements were not the same as those given in the table, but included two or more of the sections as given. In such cases the gain or loss in the larger section is divided between the sections as they are given in the table in proportion to the mileage. The results given in the table are shown graphically in figure 3. In the figure the vertical scale represents gain in cubic feet per second per mile, and the horizontal scale represents distance from the upper measurements at Platte Canyon. The hatched columns show the gains in the first seven-year period, from 1889 to 1895. The solid columns show the gains in the second seven-year period, from 1896 to 1903, excluding 1897. The difference in the heights of the two columns for any section represents the increase or decrease in the return waters for that section in the second seven-year period over the return waters for the same section for the first seven-year period. The diagram shows that between Platte Canyon and Denver the return seepage was greater for the first seven-year period than for the second. This can be accounted for by the fact that water formerly carried in open ditches and used for irrigation in this section is now taken by the Denver Union Water Company into its pipe lines and used in the city of Denver for domestic purposes. In every section from Denver to the State line the gain in the second seven-year period is greater than that in the first. The smallest increase is in the sections from Evans to the Putnam ditch, and from the Putnam ditch to Fort Morgan. The largest increase is between Fort Morgan and Snyder, and the next largest between Iliff and Crook. The small increase in gain between Evans and Fort Morgan may be accounted for by the fact that along this part of the river there have been constructed many ditches to collect seepage water (Pl. II). A large part of the seepage water which would otherwise return to the stream is collected by these ditches and used for irrigation, and hence does not show in the measurements. The large increase in the sections below Fort Morgan is doubtless due to the fact that that part of the State is only now developing. The last two sections, from Iliff to the State line, showed losses in the first period and gains in the second period. The sands of the river bed seem to be getting filled so that water flows in the surface channels, where formerly it was all lost. Taken as a whole, the measurements give every reason to believe that the flow of the stream in the lower reaches is increasing and will continue to do so. Up to the present time there has been very little storage of water and consequent irrigation in the late summer below the mouth of the Cache la Poudre. During the year 1904 two large reservoirs were constructed in this section, and plans for other reservoirs are being made. The filling of these reservoirs will make possible the use of

FIG. 1.—A CHARACTERISTIC SEEPAGE DITCH.

FIG. 2.—SEEPED SUGAR-BEET FIELD.

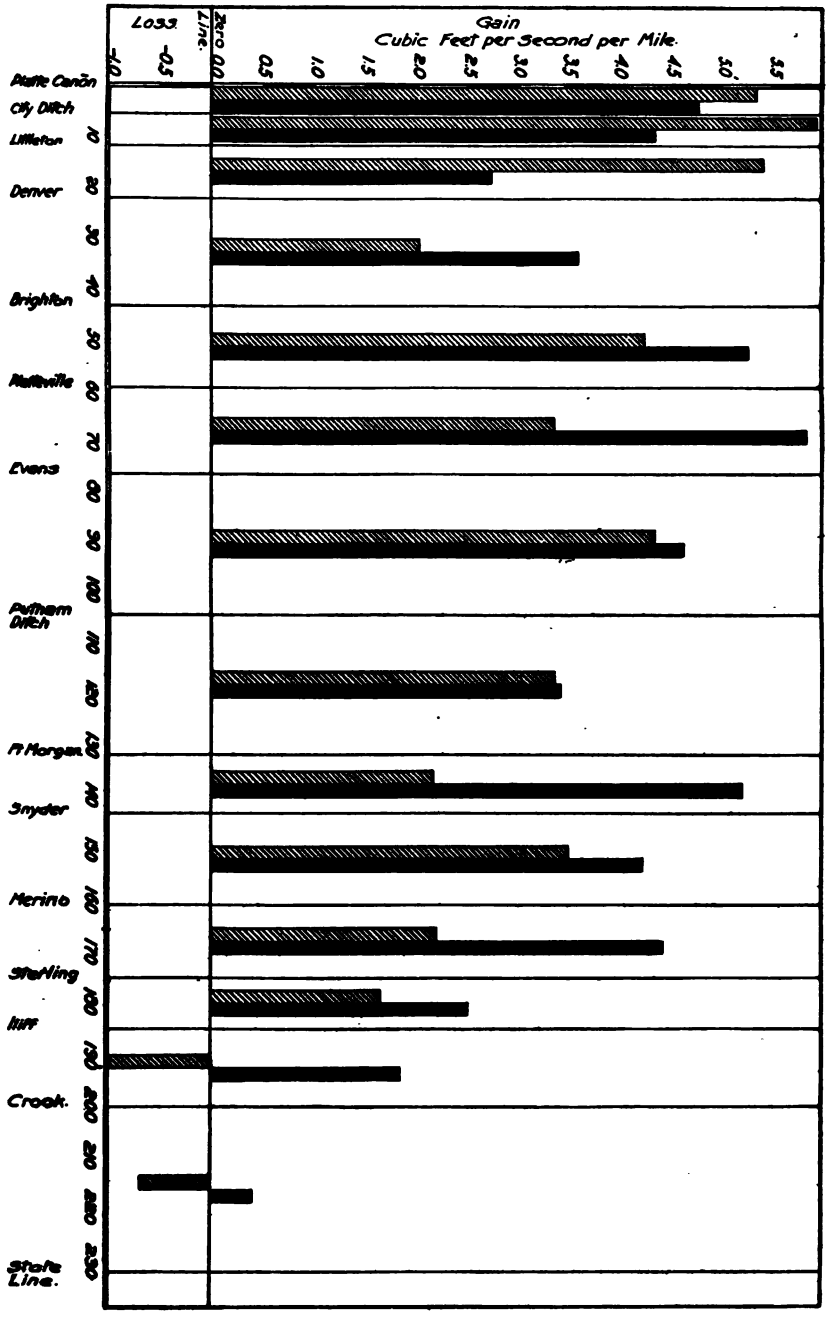


FIG. 3.—Diagram comparing volume of return seepage to South Platte River for two seven-year periods, 1889–1895 and 1896–1903, excluding 1897.

much more water in the late summer, thus keeping the soil along the stream filled with water, which will gradually find its way toward the stream.

The measurements reported in the previous tables cover periods only long enough to allow those making the measurements to travel along the course of the stream and make the measurements. All of these measurements have been made in the fall of the year when the flow is naturally small and when it is considered that most of the water in the stream comes from return seepage. These measurements are based upon the supposition that the party making the measurements will progress at about the same rate as the flow of the stream, so that any changes in that flow will not affect the results, but means have been adopted in each case to take into account any changes which might have occurred in the flow of the stream—over night, for instance. A gauge was set at night, and if there had been any change during the night new measurements were made in the morning.

It is believed, however, that records for a single day or for a few days are valuable chiefly because they are the only ones available. They are, nevertheless, conclusive as to the fact that there is a large return to the stream from this source. During the season of 1903 Mr. Adams obtained from the water commissioners of the various districts included within the drainage area of the South Platte and its tributaries daily records of the quantities of water diverted by the ditches within their respective districts. These records are more or less complete, some commissioners keeping records of the flow of all the ditches, others measuring only the larger ditches and those which it was necessary for them to regulate. Small ditches with early rights or those supplied by seepage and so located on the river that their diversions interfered with no one else were not measured in many cases. The records in district 8, which includes the section of the river from the canyon to Denver, are very largely estimates made by the water commissioner and can not be considered as accurate for the daily flow, although they probably approach accuracy for the average flow of the ditches for various months. The records in district 2, extending from Denver to the mouth of the Cache la Poudre, are practically complete and are probably quite accurate. The records in district 1, which includes the river from the mouth of the Cache la Poudre to the east line of Morgan County, are also fairly complete. Those of district 64, which extends from the east line of district 1 to the State line, are much less complete and accurate. There are a number of ditches in this district which have no decreed rights and are below any ditches which have such rights,

and consequently the water commissioner paid no attention to their diversions. On the tributaries the records of the diversions by the larger ditches are fairly complete, but in each district there is a large number of small ditches with early rights for which there are no records, so that the measurements on these tributaries can not be used in the computations of the return seepage. The flood period in the South Platte and its tributaries is usually in June. At this time flood water flows from these tributaries into the Platte and there are no measurements at their mouths, and therefore an accurate record of the supply in the main stream for the month of June can not be secured. During the months of July and August the reported diversions by the large ditches on the tributaries of the Platte leave so narrow a margin for supplying the small early ditches that it is fair to conclude that the entire flow of these tributaries is diverted during those months, and whatever water reaches the Platte from them is seepage water from the lands close to the river. For these two months, therefore, the records of flow and diversions on the South Platte will give a fair idea of the amount of return seepage in the river. The records of the stream flow are taken from the report of the United States Geological Survey (Water Supply and Irrigation Paper No. 99). Records have been kept by the Survey at South Platte, which is above all diversions; at Denver, which is on the line between districts 8 and 2; at Kersey, which is on the line between districts 2 and 1; and at Julesburg, which is at the lower end of district 64. This divides the river into three sections, one from the South Platte to Denver, which includes district 8; one from Denver to Kersey, which includes district 2; and one from Kersey to the State line, which includes districts 1 and 64. In the tables which follow the measurement at the upper station of each section gives the supply for the ditches within the section. The difference between the stream flow at the upper station and the sum of the diversions and the flow at the lower station represents the gain or loss in the section. The results of these computations are shown in the following tables. The first table gives the results for July and the second for August, 1903. These tables are based upon the supposition that none of the natural flow of the tributaries reaches the main stream. Measurements of the flow and diversions of these tributaries are complete enough to show that this is a fair assumption.

Return seepage to South Platte River, July, 1903, in cubic feet per second.

[In cubic feet per second.]

South Platte to Denver:		
River at South Platte		353
Diversions	165	
River at Denver	328	
		493
Gain		140
Percentage of gain		39.66
Denver to Kersey:		
River at Denver		328
Diversions	631	
River at Kersey	192	
		823
Gain		495
Percentage of gain		150.90
Kersey to Julesburg:		
River at Kersey		192
Diversions	636	
River at Julesburg	3	
		639
Gain		447
Percentage of gain		232.81
River as a whole:		
River at South Platte		353
Diversions	1,432	
River at Julesburg	3	
		1,435
Gain		1,082
Percentage of gain		307.08

Return seepage to South Platte River, August, 1903, in cubic feet per second.

South Platte to Denver:		
River at South Platte		217
Diversions	146	
River at Denver	108	
		254
Gain		37
Percentage of gain		17.05
Denver to Kersey:		
River at Denver		108
Diversions	384	
River at Kersey	137	
		521
Gain		413
Percentage of gain		382.41

Kersey to Julesburg:		
River at Kersey		137
Diversions	302	
River at Julesburg	130	
		432
Gain		295
Percentage of gain		215.33
Stream as a whole:		
River at South Platte		217
Diversions	833	
River at Julesburg	[a]130	
		963
Gain		746
Percentage of gain		343.73
Gain, excluding flow at Julesburg		616
Percentage of gain, excluding flow at Julesburg		283.41

The tables show that for July, on the stream as a whole, the average gain for the whole stream between South Platte and the State line is 1,082 cubic feet per second, and the diversions are slightly more than four times the supply at the upper station. For August the average gain, excluding a large flow at Julesburg, which was due to local rains, is 616 cubic feet per second, and the average diversions were nearly three times the supply at the upper station.

These records show, however, that very little surface flow from either the natural flow of the stream or return seepage passes the State line. The average for July is but 3 cubic feet per second and that for August 130 cubic feet per second, but this high average is due to a large flow on a very few days caused by heavy local rains. The average flow for the month of August outside of these few days is but little larger than that for July.

The fact that the tributaries of the Republican River rise so close to the South Platte and the fact that the stream has from the earliest settlement gone dry or nearly so in the sections below the mouth of the Cache la Poudre, have given rise to the belief that the water of the Platte sinks into the sand and finds its way into the tributaries of the Republican. To test the correctness of this theory Mr. W. W. Follett, under the direction of the late Col. E. S. Nettleton, made a series of measurements in 1891.[b] The water levels in lines of wells crossing the valley of the South Platte at various points were measured to determine whether or not the water-bearing strata were above or below the level of the Platte at the points crossed. Mr. Follett's measurements show that west of the Colorado-Nebraska line the water in the wells measured and in the Frenchman branch of the

[a] Largely due to heavy local rains August 16 and 23.

[b] 52d Cong., 2d Sess., Ex. Docs. 41, 42.

Republican is above that of the Platte, and his conclusion is that this water comes from local precipitation. On the other hand, the water in the wells on a line passing north and south through North Platte is in a gravel stratum on a level with or below the South Platte, which extends to the tributaries of the Republican.

While these measurements are not conclusive, since the wells observed west of the State line do not go below the level of the Platte, and therefore do not prove that the water from the river does not get away to the south on a level lower than the wells, they seem to indicate that in Colorado the water of the Platte is retained in its own valley, either in the surface stream or as an underflow, and that somewhere between the State line and North Platte the water begins to flow away from the valley as underflow and contributes to the flow of the tributaries of the Republican. The measurements made by Mr. Follett east of North Platte showed that these conditions exist along the river as far as Grand Island, where the measurements were discontinued.

The measurements of return seepage given in the table seem to bear out Mr. Follett's conclusions as regards the stream in Colorado. Irrigation along the stream has brought about a gradual increase in return waters which has now reached the State line. Mr. Follett's measurements give reason to suppose that this increase will not be as rapid in Nebraska as it has been in Colorado, on the supposition that not all the water used in the valley of the Platte will be retained within the valley, either in the surface stream or the sands of the valley. The volume of return water in the surface streams will depend upon whether the supply added to the underground water by irrigation is greater than that which is lost through the underflow into the tributaries of the Republican and by evaporation. The velocity of underflow is supposedly very slow, and a large use of water in irrigation would probably supply it faster than it could be carried away by this underflow and would tend to produce a flow in the river. On the other hand, the bed of the stream in Nebraska is broader than it is above and evaporation will always be a source of great loss.

The general conclusion regarding the effect of irrigation in Colorado upon the supply of water in Nebraska is that the use of the water of the Platte in Colorado has reduced the size of the spring floods, and also to a less extent the flow in the late summer, but this summer flow has always been very unreliable. At present the improvement in the flow of the stream during the late summer due to return seepage has reached the State line and may be expected to continue down the stream. In that case the conditions along the stream in Nebraska will be better than they have ever been before. The floods will be less, but the supply after the floods have subsided will be

more reliable. Under the present arrangements there are irrigated from the South Platte and tributaries in Colorado about 750,000 acres of land yielding annual crops worth from $15 to $1,000 per acre,[a] supporting a large population in comfort, not only without working any lasting harm to the farmers in Nebraska, but actually improving their water supply. Stopping the use of the water in Colorado might increase the supply in Nebraska for a few years, until the water supplied to the soil by years of irrigation had drained out, but there is every reason to believe that eventually the river would return to its former condition, and Nebraska would receive no lasting benefit, while Colorado would suffer the loss due to the return of 750,000 acres from intensively cultivated and highly productive farms to their original desert condition or worse, because the natural grasses have been destroyed. This would involve the loss of the capital invested in irrigation works, in railroads, in sugar factories, in farm buildings and implements, and in all the industries and business enterprises which are supported by a prosperous agricultural community. It would mean the ruin of other industries which now run on a narrow margin of profit, because of the increased cost of living due to the stopping of the local production of a food supply.

Even assuming that the natural flow of the stream would reach Nebraska if it were not used in Colorado, its use in Nebraska would necessitate the construction of new canals, farm buildings, grain elevators, mills, sugar factories, business houses, and residences. All over the United States the development of new sections by irrigation has been attended with financial losses and misunderstandings and recriminations between investors in irrigation works and the settlers under these works. The South Platte Valley in Colorado has passed through this period. At present 85 per cent of the land in the valley is watered by ditches owned by the farmers, and a satisfactory and economical system of ditch management has been worked out. This condition has been reached only after years of trouble between investors and settlers.

Under present conditions the water used on the lands near the headwaters returns in part to the streams to be used again farther down along their courses. This process continues down to the State line

[a] Mr. Adams collected complete crop returns for 24,329 acres, showing annual returns of $19.84 per acre. This land was not in the most highly productive section of the valley. The area planted to sugar beets in 1903 was 15,973 acres, with an average production of 13.46 tons per acre. At $4.50 per ton, the usual price, this is $60.57 per acre, a total of $967,484 for the whole area. Raspberries yielded as high as $1,018 per acre, potatoes $80 to $85 per acre, and alfalfa $15 per acre. The acreages of these various crops are not available, hence no statement of total crop returns can be made.

and will probably extend on into Nebraska. Supposing the use in Colorado is stopped and supposing the water reaches Nebraska, the return seepage, which will not be as great as it is in Colorado (see p. 56) will reach the stream below where water is needed for irrigation, and there will be but one use of water where now it is used over and over.

Considered from an economic standpoint, the maintenance of the present status means the largest possible use of the water supply, since irrigation begins where the streams issue from their canyons, allowing the fullest opportunity for seepage return to the streams. It means the preservation of the homes and industries of the South Platte Valley in Colorado and the maintenance of the institutions which are the outgrowth of nearly a half century's experience, while Nebraska will receive a gradually increasing supply of water, which will eventually be better than would result from the stopping of irrigation in Colorado.

RIGHTS TO WATER FROM NORTH PLATTE RIVER AND TRIBUTARIES.

COLORADO.

The course of the North Platte lies in three States. The nature of rights to the use of water in Colorado has been discussed on page 26. In Wyoming, up to 1890, rights were acquired by diverting water and using it, but since that time they have been acquired by securing a permit from the State engineer, constructing works, and using the water. Rights acquired prior to 1890 are defined by the board of control, on the testimony of the interested parties and on surveys and measurements made by the State engineer and his assistants. Water-right holders are entitled to sufficient water for stated areas, with the limitation that no more than 1 cubic foot per second can be used for 70 acres.

The North Platte and its tributaries in Colorado are in districts 46 and 47. Irrigation began in these districts in the early eighties and the rights were first adjudicated in 1892. The records of these adjudications show that in both districts the rights were based on the areas actually irrigated and were computed on the assumption that in district 46 one cubic foot per second will supply 40 acres and in district 47 it will supply 50 acres. Where a right computed in this way exceeded the capacity of the ditch which served the land the right was limited to the capacity of the ditch.

Second adjudications took place in 1900 for district 46 and in 1902 for district 47. In these adjudications the rights of those who were not represented in the first one and of those who acquired rights since these adjudications were defined. They were computed in the same

way as in the first adjudications, except that the duty of water was differently estimated. Testimony was introduced to show that 100 acres of bottom land required 2 cubic feet of water per second; 100 acres of upland required 2.5 cubic feet of water per second, except along the Canadian River, where 100 acres required 3 cubic feet of water per second. These estimates were followed in computing the rights in the second adjudication. Although these rights were based upon the acreages actually irrigated, their owners are held to have rights to fixed quantities rather than to sufficient water for the lands irrigated. Any economy in use on their part would, therefore, give them a surplus of water which could be disposed of by them rather than left in the stream to supply lands lying farther down on the stream. Rights in these districts, as defined in the decrees above referred to, are shown in the following table:

Rights decreed from North Platte River and tributaries in Colorado, districts 46 and 47.

Date of priority.	Area irrigated.	Rights decreed.	Sum to date.	Date of priority.	Area irrigated.	Rights decreed.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*		*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1880	200	4.00	4.00	1892	170	4.00	2 073.85
1881	100	2.50	6.50	1893	3,780	98.56	2,167.41
1882	775	26.50	33.00	1894	3,335	82.45	2,249.86
1883	2,180	44.00	77.00	1895	1,980	49.05	2,298.91
1884	2,235	46.50	123.00	1896	1,490	32.47	2,331.38
1885	6,925	136.00	259.50	1897	2,840	69.60	2,400.98
1886	4,670	99.00	358.50	1898	4,025	113.55	2,514.53
1887	18,375	381.05	739.55	1899	1,240	39.90	2,554.43
1888	24,913	568.55	1,308.10	1900	5,100	127.50	2,681.93
1889	16,292	363.50	1,671.60	1901	3,350	67.25	2,749.18
1890	13,080	292.25	1,963.85				
1891	5,375	106.00	2,069.85	Total	122,430	2,749.18	

WYOMING.

The rights to the tributaries of the North Platte in Wyoming have been adjudicated by the board of control, but those to the river itself have not been. The various streams are independent of each other, but the rights to water from them are subject to prior rights on the main stream. They can not therefore be considered absolutely settled until the main stream is adjudicated and a general table for the stream and its tributaries is made up. They are, however, practically settled, because the main stream supplies sufficient water for existing rights, and any rights acquired in the future will be subsequent to the rights on the tributaries. In making up this table the river is divided into three sections. The upper section extends from the Colorado line to Fort Steele, the middle section from Fort Steele to Guernsey, and the lower section from Guernsey to the Wyoming-Nebraska line.

Rights to water from the tributaries of North Platte River in Wyoming.

Date of priority.	Upper section.	Middle section.	Lower section.	Total.	Total area irrigated.
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*	*Acres.*
1868		0.54	1.00	1.54	
1869			1.57	1.57	110
1870		.53		.53	
1871		1.71	31.00	32.71	2,290
1872			1.97	1.97	138
1873		.75	6.26	7.01	495
1874		5.35	14.71	20.06	1,270
1875	2.30	4.10	20.61	27.01	1,868
1876	3.60	4.40	58.17	60.17	4,189
1877		5.43	27.64	33.07	2,313
1878	14.75	8.27	53.97	76.99	5,377
1879	23.80	37.11	26.13	87.04	6,100
1880	3.42	7.72	40.61	51.75	3,607
1881	11.08	15.50	119.62	146.20	10,280
1882	40.91	31.63	72.51	145.05	10,100
1883	25.37	68.04	745.99	839.40	58,706
1884	92.98	79.00	241.67	413.60	28,870
1885	141.89	280.64	198.36	615.89	42,869
1886	63.11	197.04	135.04	395.19	26,807
1887	81.23	92.97	238.57	412.77	28,697
1888	66.11	60.41	167.46	293.98	20,531
1889	54.88	57.01	44.60	156.49	10,877
1890	41.33	31.36	148.40	221.09	15,456
1891	53.82	30.32	30.72	114.80	8,007
1892	13.98	28.54	36.28	78.80	5,501
1893	9.77	33.37	2.28	45.42	3,243
1894	27.60	12.26	21.51	61.37	4,300
1895	56.20	62.84	37.77	156.81	10,975
1896	17.74	124.60	27.80	170.14	11,910
1897	18.68	72.81	16.60	108.09	7,559
1898	20.12	98.65	13.18	131.95	9,234
1899	28.30	87.48	11.67	122.45	8,577
1900	3.14	44.33	9.21	56.68	3,967
1901	8.86	69.43		78.29	5,480
Total	919.92	1,644.14	2,591.88	5,155.94	359,673

There are on record in the State engineer's office several claims to water from the main stream filed before the adoption of the present law, and also a large number of approved applications filed under the present law. No certificates of completed appropriations can be issued until an adjudication is had in which the rights acquired under the Territorial laws have been defined. The records show, however, where proof of completion has been made and what permits have been canceled. The following table, made up from the records of the Wyoming State engineer's office, shows the status of rights so far as that office is concerned:

Rights to water from North Platte River in Wyoming, as shown by the records of State engineer's office.

Year.	Works completed.		No final action.		Territorial claims.		Total in force.	
	Acres.	*Cu. ft. per second.*	*Acres.*	*Cu. ft. per second.*	*Acres.*	*Cu. ft. per second.*	*Acres.*	*Cu. ft. per second.*
1875					1,080	264.50		
1880					215			
1882					700			
1883					5,360	106.22		
1885					12,680	92.39		
1886					15,996			
1888					8,200			
1889					1,700			
1890					671,800	9,554.00		
1891			11,500	164.3	1,000,000	4,500.00	11,500	164.3
1893	11,080	158.3	280	4.0			11,360	162.3
1894	800	11.4	15,560	222.2			16,360	233.7
1895	20	.3	10,493	149.9			10,513	150.2
1896	204	2.9	3,000	43.0			3,204	45.9
1897	166	2.4					166	2.4

Rights to water from North Platte River in Wyoming, etc.—Continued.

Year.	Works completed.		No final action.		Territorial claims.		Total in force.	
	Acres.	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*
1898	2,195	31.4	781	11.1	.....	.....	2,976	42.5
1899	200	3.0	.....	.....	.....	.....	200	3.0
1900	199	2.8	.....	.....	.....	.....	199	2.8
1901	275	4.0	20,170	288.0	.....	.....	20,445	292.0
1902	550	7.9	63,883	912.6	.....	.....	64,433	920.5
1903	.....	.....	2,132	30.6	.....	.....	2,132	30.6
1904[a]	.....	.....	51,144	730.6	.....	.....	51,144	730.6
Total	15,689	224.4	178,943	2,556.3	.....	.....	194,632	2,780.8

[a] To August 15.

The rights given in the table as completed can be considered as settled, except as to the number and volume of prior rights; part of those on which no action has been taken will be canceled, while a part are probably good. For those dated 1901 and later there is yet considerable time in which to complete the work authorized. The larger claims filed under the Territorial law are of no account, as the works were never built. Some of the smaller claims probably are good. There is little irrigation along the stream, except in the section just above the Wyoming-Nebraska line. Since the rights have not been defined, no exact statement as to their volume or date of acquirement can be made. Under the Wyoming laws an appropriator is entitled to sufficient water for the land which he has irrigated, with a limit of 1 cubic foot per second to 70 acres. A table has been made up showing approximately the areas irrigated along the stream, and the quantities of water to which the owners of these lands are entitled have been computed on the basis of 1 cubic foot per second for 70 acres. This is shown in the following table. In making up this table the river was divided into three sections, as in the table showing the rights to the tributaries. The Mitchell ditch, which diverts water just above the Wyoming-Nebraska line for use in Nebraska, is not included.

Approximate appropriations by ditches in Wyoming from North Platte River.

Date of priority.	Upper section.	Middle section.	Lower section.	Total appropriations.	Sum to date.	Total area irrigated.
	Cu.ft.per second.	*Cu.ft.per second.*	*Cu.ft.per second.*	*Cu.ft.per second.*	*Cu.ft.per second.*	*Acres.*
1885	45.72	.....	14.28	60.00	60.00	4,200
1886	.....	.....	5.00	5.00	65.00	350
1887	5.00	.....	.....	5.00	70.00	350
1888	16.29	10.00	50.00	96.29	146.29	5,340
1891	.....	.....	41.45	41.45	187.74	2,900
1893	.....	11.45	70.00	81.45	269.19	5,700
1894	.....	11.45	.....	11.45	280.64	800
1895	.....	1.15	.....	1.15	281.79	80
1896	.....	2.92	.....	2.92	284.71	204
1897	.....	2.37	.....	2.37	287.08	166
1898	7.15	7.00	.....	14.15	301.23	990
1899	.....	5.00	2.86	7.86	309.09	550
1900	.....	.....	5.00	5.00	314.09	350
1901	3.58	.....	400.00	403.58	717.67	28,250
1902	34.57	3.45	.....	38.02	755.69	2,661
Total	112.31	54.79	588.59	.....	.....	52,891

Taking the estimate for the rights initiated before 1891, when the present law became operative, from the above table and the records of the engineer's office for the rights initiated since that time gives a total of 2,927 cubic feet per second as the rights to water from the North Platte in Wyoming. The rights to water from the tributaries aggregate 5,155.94 cubic feet per second.

One of the tributaries of the North Platte—the Laramie River—is also an interstate stream and, so far as Colorado and Wyoming are concerned, is entirely independent of the North Platte. The Laramie River in Colorado is in district 48. The rights to water in this district were adjudicated in 1896. The decree states the number of acres of land irrigated by each ditch, and awards to each "—— cubic feet of water per second of time, or so much thereof as may be necessary to irrigate —— acres of land." The number of acres of land in each case is the number found to be irrigated by the ditch. The right is thus restricted to the needs of a given area of land within the maximum limit fixed by the decree. This form of decree is exceptional in Colorado and places rights substantially on the same basis as in Wyoming; that is, the appropriator has not a right to a fixed quantity of water, but to sufficient water for his land which he has irrigated at the time of the making of the decree.

This form of decree prevents probably the worst abuse which has arisen under the water laws of Colorado. In other districts the courts decreed rights to volumes much larger than had ever been used by the holders of rights. In later years the use was enlarged by the holders of these excessive decrees, thus depriving those who have been using water perhaps for years and long prior to the increased use by the holders of early rights. Under the decree in district 48 this is impossible, as the water-right holder has only a right to irrigate a fixed area. The maximum limits fixed in the decree seem to bear no relation to the areas irrigated by the ditches. In most cases they equal the full capacities of the ditches, as stated by their owners. One exception to the general wording of the decree was made in the case of the Laramie River ditch, which carries water from the Laramie into the Cache la Poudre. The decree gives to the owners of this ditch the right to 400 cubic feet per second of water from the Laramie and its tributaries for direct irrigation, and the right to store 500,000,000 cubic feet of water annually. The following table gives the areas stated in this decree, together with the maximum quantities of water which can be diverted for their irrigation:

Decreed rights to water from Laramie River, in Colorado.

Year.	Area irrigated.	Maximum volume decreed.	Sum to date.	Year.	Area irrigated.	Maximum volume decreed.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*		*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1880	300	30.84	30.84	1891	[a]30,000	[a]400.00	649.20
1881	635	51.23	82.07	1892	280	7.40	656.60
1882	795	58.18	140.25	1893	300	25.14	681.74
1883	920	39.56	179.81	1894	400	39.22	720.96
1884	540	37.94	217.75	1896	385	24.53	745.49
1887	640	14.50	232.25				
1888	80	3.07	235.32	Total	35,535		
1890	260	13.88	249.20				

[a]All this acreage is in district 3 and the entire appropriation is for Laramie River ditch. Water from other sources also is used in the irrigation of this land.

Rights to the Laramie River in Wyoming were adjudicated in 1903. According to the usual practice in Wyoming, the decree determined the areas irrigated by the various claimants, and these claimants are entitled to sufficient water for the tracts irrigated, with a limit of 1 cubic foot per second for 70 acres. The following table gives the areas and the volumes to which they are entitled on this basis:

Rights to Laramie River in Wyoming.

Year.	Area.	Volume.	Sum to date.	Year.	Area.	Volume.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*		*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1875	318.00	4.54	4.54	1889	213.00	3.04	950.26
1877	1,325.00	18.93	23.47	1890	5,140.00	73.43	1,023.69
1878	235.00	3.36	26.83	1891	1,553.50	16.48	1,040.17
1879	920.00	13.14	39.97	1892	2,390.00	34.14	1,074.31
1881	2,686.07	38.37	78.34	1894	196.00	2.80	1,077.11
1882	1,284.00	18.34	96.68	1895	1,680.00	24.00	1,101.11
1883	42,042.05	600.60	697.28	1896	1,128.70	16.12	1,117.23
1884	9,018.00	128.83	826.11	1897	904.00	12.91	1,130.14
1885	1,516.00	21.66	847.77	1898	240.00	3.43	1,133.57
1886	1,948.00	27.97	875.74	1899	50.00	.71	1,134.28
1887	2,299.00	32.84	908.58				
1888	2,425.00	38.64	947.22	Total	79,111.32		

NEBRASKA.

Nebraska, like Wyoming, grants sufficient water to irrigate a given area rather than a fixed volume of water. The rights to the North Platte were adjudicated soon after the passage of the law of 1895. The owners of ditches commenced prior to 1895 filed claims under the law of 1889. Those commencing ditches after that date had filed applications with the State board and received permits to proceed with the work. The secretary of the board and his assistants made surveys and prepared maps of the river, the ditches, and the irrigated lands. Hearings were then held at various points by the secretary of the board. At these hearings, in addition to the submission of the sworn statements of claims, evidence was introduced by the various parties. When a ditch owner had filed a claim in accordance with the law of 1889, his right was held to date from the filing of the

claim, otherwise from the date of first use of the water. Many of the ditches begun prior to the passage of the law of 1895 had not been completed at the time of the hearing, and those built on permits from the State board were also unfinished. In the case of the rights initiated before 1895 the board determined the plans of the applicants and based their rights on these plans, fixing the time within which the water should finally be applied to the land. The permits issued by the board in a similar way stated the time within which the water should be put to use. The adjudication, therefore, was not final as regards rights acquired either before or after 1895. In the case of the Farmers' Irrigation District *v.* Frank[a] the supreme court of the State has held that the board had no power to grant rights to parties constructing ditches prior to 1895, and that its function was merely to determine existing rights. Applying this ruling to the adjudications made by the board on the North Platte, the court held that the Farmers' Irrigating Company has a right to the full amount which the board determined that it would acquire by the completion of its works and applying water to the land by September 1, 1904. This company built only a small section of its ditch and reclaimed a very small area of land. Since the decision of the board no more work has been done and very little more land has been reclaimed. yet under this ruling of the court the ditch has a right to the full quantity of water and can lose this right only by ten years' nonuse.[b] Many other rights along the North Platte are in the same condition. The following table gives the rights as determined by the board. In the table rights initiated prior to 1895 and the applications approved since that date are given separately.

Rights to water from North Platte River in Nebraska.

Date of priority.	Appropriation.	Area to be irrigated.
	Cubic feet per second.	*Acres.*
Rights conditionally granted:		
1884	156.16	10,931
1887	1,142.86	80,000
1888	211.43	14,800
1889	532.67	37,287
1890	85.06	5,954
1891	30.86	2,160
1892	275.37	19,276
1893	471.85	33,030
1894	1,040.41	72,830
1895	217.63	15,234
Total	4,164.30	291,502
Applications approved:		
1895	104.48	7,313
1896	147.55	10,328
1897	530.00	37,100
1899	400.00	28,000
Total	1,182.03	82,741

[a] 100 N. W., p. 286.

[b] Since this was written work has been resumed, and the canal is being extended according to the original plan.

The rights to the main Platte River in Nebraska are given in the following table:

Rights to water from Platte River in Nebraska.

Date of priority.	Appropriation.	Area to be irrigated.
	Cubic feet per second.	*Acres.*
Appropriations conditionally granted:		
1890	[a] 200.00	
1894	3,346.24	234,237
1894	[a] 240.00	
1895	945.72	66,200
Total	4,731.96	300,437
Applications approved:		
1896	214.00	14,980
1897	242.14	16,950
1900	289.64	20,275
Total	745.78	52,205

[a] For irrigation and power.

INTERSTATE RELATIONS.

COLORADO-WYOMING.

Statements of the rights to the North Platte in the States of Colorado and Wyoming are given on pages 60, 61. Only the rights on the main stream in Wyoming are in any way dependent on the use of the water in Colorado, and in the table given below the rights in Wyoming are those to water from the main stream rather than to the stream and its tributaries.

Rights to the North Platte River in Colorado and Wyoming.

Year.	Colorado.		Wyoming.	
	Rights acquired.	Sum to date.	Rights acquired.	Sum to date.
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1880	4.00	4.00	----------	----------
1881	2.50	6.50	----------	----------
1882	26.50	33.00	----------	----------
1883	44.00	77.00	----------	----------
1884	46.50	123.50	----------	----------
1885	136.00	259.50	60.00	60.00
1886	99.00	358.50	5.00	65.00
1887	381.05	739.55	5.00	70.00
1888	568.55	1,308.10	76.29	146.29
1889	363.50	1,671.60	----------	146.29
1890	292.25	1,963.85	----------	146.29
1891	106.00	2,069.85	164.30	310.59
1892	4.00	2,073.85	----------	310.59
1893	93.56	2,167.41	162.30	472.89
1894	82.45	2,249.86	233.70	706.59
1895	49.05	2,299.91	150.20	856.79
1896	32.47	2,331.38	45.90	902.69
1897	69.60	2,400.98	2.40	905.09
1898	113.55	2,514.53	42.50	947.59
1899	39.90	2,554.43	3.00	950.59
1900	127.50	2,681.93	2.80	953.39
1901	67.25	2,749.18	292.00	1,245.39
1902	----------	----------	920.50	2,165.89
1903	----------	----------	30.60	2,196.49
1904	----------	----------	730.60	2,927.09

This table shows that the first rights in Wyoming were acquired in 1885, and that prior to this there were in Colorado rights to 123.5 cubic feet per second. The principal volume of the rights in Colorado were acquired in the years 1885 to 1891, more than two-thirds of the rights dating in these years. These are all prior to any considerable volume of rights in Wyoming. The greater part of the rights in Wyoming were acquired since 1900 and subsequent to practically all the rights in Colorado. As between the two States, therefore, Colorado has the earlier rights to the river.

Natural conditions are such that there is little likelihood of any conflict between appropriators in the two States. Most of the land irrigated in Colorado is in small areas immediately adjoining the stream and sloping rapidly toward the stream, and a large part of the water applied will soon return to the river. Practically the only crop raised is native hay, which requires water only during the flood season, when there is no shortage anywhere along the river. For 30 miles north of the State line the river runs through a succession of canyons and between hills, which prevent its diversion for irrigation, while in this distance a number of tributaries discharge into the river. The valley then widens out somewhat, and in the course of the next 10 miles to the town of Saratoga considerable land is irrigated, and further development will probably take place in this region. Applications for large appropriations have recently been filed with the State engineer. From the vicinity of Saratoga the North Platte flows for 250 miles with almost no ditches diverting its water. In this section there are a number of tributaries to the river. In the last 30 miles of the river's course in Wyoming the valley widens out, and most of the appropriations from the North Platte in Wyoming are in this section.

Because of the long distance between this irrigated valley and Colorado it is not probable that use in Colorado will affect Wyoming irrigators. The appropriators in Colorado were undoubtedly decreed rights very much in excess of what they have ever used, but natural conditions are such that they can not make such an increased use of the water as to deprive appropriators in Wyoming.

Laramie River.—So far as Colorado and Wyoming are concerned, the Laramie River is independent of the North Platte. As shown on page 62, rights to the Laramie River in the two States were determined on the same basis. With one exception appropriators in both States are given the right to sufficient water for certain areas of land.

The following table shows the rights to this stream in the two States. For Colorado the areas are given and the maximum quantities which may be diverted by the ditches serving these areas. As pointed out before, these maximum quantities bear no relation to the areas irrigated. For Wyoming the areas are given and the maxi-

SKY-LINE DITCH, CARRYING WATER FROM LARAMIE RIVER DRAINAGE TO CACHE LA POUDRE DRAINAGE.

mum quantities of water on the basis of 1 cubic foot per second for 70 acres.

Rights to Laramie River in Colorado and Wyoming.

Year.	Colorado.			Wyoming.		
	Area.	Rights acquired.	Sum to date.	Area.	Rights acquired.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*	*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1875				318.00	4.54	4.54
1877				1,325.00	18.93	23.47
1878				235.00	3.36	26.83
1879				920.00	13.14	39.97
1880	300	30.84	30.84			39.97
1881	635	51.23	82.07	2,686.07	38.37	78.34
1882	795	58.18	140.25	1,284.00	18.34	96.68
1883	920	39.56	179.81	42,042.05	600.60	697.28
1884	540	37.94	217.75	9,018.00	128.83	826.11
1885			217.75	1,516.00	21.66	847.77
1886			217.75	1,948.00	27.97	875.74
1887	640	14.50	232.25	2,299.00	32.84	908.58
1888	80	3.07	235.32	2,425.00	38.64	947.22
1889			235.32	213.00	3.04	950.26
1890	260	13.88	249.20	5,140.00	73.43	1,023.69
1891	30,000	400.00	649.20	1,153.50	16.48	1,040.17
1892	280	7.40	656.60	2,390.00	34.14	1,074.31
1893	300	25.14	681.74			1,074.31
1894	400	39.22	720.96	196.00	2.80	1,077.11
1895			720.96	1,680.00	24.00	1,101.11
1896	385	24.53	745.49	1,128.70	16.12	1,117.23
1897				904.00	12.91	1,130.14
1898				240.00	3.43	1,133.57
1899				50.00	.71	1,134.28
Total	35,535			79,111.32		

The table shows that prior to 1880, when the first appropriation was made in Colorado, 2,798 acres had been irrigated in Wyoming, giving its owners the right to 40 cubic feet per second. There is little irrigation in Colorado in the valley of the Laramie and its tributaries, and diversions by ditches in this valley do not noticeably deplete the supply for Wyoming. There is, however, conflict over the diversions by the Water Supply and Storage Company of Colorado, which takes waters from the headwaters of the Laramie over the divide into the Cache la Poudre for use in the valley of that stream (Pl. III). While many others are interested in this contest, the settlers under the canals of the Wyoming Development Company are the principal users of water from the Laramie in Wyoming, and will be the chief sufferers from diversions in Colorado. The right of the Wyoming Development Company to water something over 35,000 acres is dated 1883, while the right of the Water Supply and Storage Company to 400 cubic feet per second was acquired in 1891, according to the Colorado decree. There are, prior to the right of the Water Supply and Storage Company, rights to irrigate 71,369 acres in Wyoming, giving a right to 1,019.56 cubic feet per second.

The following table giving the average flow of the Laramie River at Woods Landing, near the State line, shows that these rights in Wyoming would practically exhaust the supply of the stream. The measurements are taken from reports of the State engineers of Wyoming.

Mean discharge of Laramie River at Woods Landing, Wyo., 1889–1891 and 1896–1900.

	Cubic feet per second.
April	230. 60
May	1, 102. 15
June	1, 377. 20
July	379. 94
August	636. 27
September	78. 41

This diversion by the Water Supply and Storage Company stands on a different basis from the other rights as related to natural conditions as well as in its nature, as defined by the court. Much of the water diverted and used in the valleys of the headwaters of the Laramie returns to the streams as seepage and helps to supply rights in Wyoming. That diverted by the Water Supply and Storage Company, however, is carried into the drainage area of another stream and hence there is no return seepage.

Two series of measurements of return seepage have been made along the Laramie River. The first series, made by B. P. Fleming, of the Wyoming Experiment Station, shows that between Woods Landing, near the State line, and the tunnel of The Wyoming Development Company, below which there are few diversions, there is a gain in the flow of the stream of 13.08 cubic feet per second, or 0.16 cubic foot per second per mile. This gain is not sufficient to make any appreciable change in the flow of the river, but the measurements indicate that if water should be turned down from the upper ditches it would reach the ditches in Wyoming. The second series of measurements was made by C. E. Tait, of this Office. Mr. Tait's measurements show a slightly larger gain—21.64 cubic feet per second, or 0.22 cubic foot per second per mile. These measurements, like the others, indicate that water, if turned down the stream, would not be lost to the lower ditches.

Sand Creek, a tributary of the Laramie, is also an interstate stream. There are few diversions for use in the valley of Sand Creek in Colorado, but its water, like that of the Laramie, is diverted into the headwaters of the Cache la Poudre. This diversion was made in 1902 and is, therefore, later than all the rights in Wyoming. As in the case of the Laramie, none of this water diverted will return as seepage to Sand Creek. Wyoming appropriators brought suit against the Colorado parties making these diversions, and an injunction has been granted restraining the Colorado parties from diverting the waters of Sand Creek on the ground that "the right to divert running waters for irrigating lands in an arid country is not controlled or affected by political divisions."[a]

[a] Hoge *v.* Eaton, 135 Fed., 411.

Theoretically and on the assumption that State lines should be ignored all rights to the North Platte and its tributaries in both Colorado and Wyoming are subject to prior rights in Nebraska. In the table given below the rights in the three States are brought together. The ditches in Colorado have been decreed absolutely the quantities given in the table. The volumes given for Wyoming and Nebraska are the maximum quantities to which the lands in these States are entitled, on the basis of 1 cubic foot per second to 70 acres:

Rights to water from North Platte River and tributaries in Colorado, Wyoming, and Nebraska.

Year.	Colorado.	Wyoming.	Total Colorado and Wyoming.		Nebraska.	
			Rights acquired.	Sum to date.	Rights acquired.	Sum to date.
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1868		1.54	1.54	1.54		
1869		1.57	1.57	3.11		
1870		.53	.53	3.64		
1871		32.71	32.71	36.35		
1872		1.97	1.97	38.32		
1873		7.01	7.01	45.33		
1874		20.06	20.06	65.39		
1875		27.01	27.01	92.40		
1876		60.17	60.17	152.57		
1877		33.07	33.07	185.64		
1878		76.99	76.99	262.63		
1879		87.04	87.04	349.67		
1880	34.84	51.75	86.59	436.26		
1881	53.73	146.20	199.93	636.19		
1882	84.68	145.05	229.73	865.92		
1883	83.56	839.40	922.96	1,788.88		
1884	84.44	413.60	498.04	2,286.92	156.16	156.16
1885	186.00	675.89	811.89	3,098.81		156.16
1886	99.00	390.19	489.19	3,588.00		156.16
1887	396.55	417.77	813.32	4,401.32	1,142.86	1,299.02
1888	571.62	390.27	961.89	5,363.21	211.43	1,510.45
1889	363.50	156.49	519.99	5,883.20	532.67	2,043.12
1890	306.13	221.09	527.22	6,410.42	285.06	2,328.18
1891	506.00	279.10	785.10	7,195.52	30.86	2,359.04
1892	11.40	78.80	90.20	7,285.72	275.37	2,634.41
1893	118.70	207.72	326.42	7,612.14	471.85	3,106.26
1894	121.67	295.07	416.74	8,028.88	4,386.65	7,492.91
1895	49.05	307.01	356.06	8,384.94	1,267.83	8,760.74
1896	57.00	216.04	273.04	8,657.98	361.55	9,122.29
1897	69.60	110.49	180.09	8,838.07	772.14	9,894.43
1898	113.55	174.45	288.00	9,126.07		9,894.43
1899	39.90	125.45	165.35	9,291.42	400.00	10,294.43
1900	127.50	59.48	186.98	9,478.40	289.64	10,584.07
1901	67.25	370.29	437.54	9,915.94		
1902		920.50	920.50	10,836.44		
1903		30.60	30.60	10,867.04		
1904		730.60	730.60	11,597.64		

The table shows that the earliest right in Colorado was acquired in 1880, the earliest right in Wyoming in 1868, and the earliest right in Nebraska in 1884. There are, in the upper States, rights prior to any in Nebraska acquired by appropriation, amounting to 1,788.88 cubic feet per second. The main question is, however, regarding rights immediately above and below the Wyoming-Nebraska State line. As between these the ditches in Nebraska were built prior to most of those in Wyoming, the largest rights in the lower section in Wyoming

having been initiated in 1901 and since, subsequent to all of those in Nebraska.

In addition to the rights enumerated in the table for Nebraska, there are rights to water attaching to riparian lands. (See p. 85.) The earliest settlements along the North Platte in Nebraska, except in the immediate vicinity of the city of North Platte and a few isolated ranches, were made in 1883 and the years following. Prior to that year rights to 865.92 cubic feet per second had been acquired in Colorado and Wyoming. The railroad land grant extends up the South Platte, and the North Platte enters the limits of the grant in the neighborhood of Lewellen (see map, Pl. I), consequently there are no railroad lands west of that point. In the vicinity of Lewellen railroad lands were selected in 1902, and therefore have no riparian rights, under the decision that the law of 1889 abrogated the rule of riparian rights. Through Deuel County for a distance of about 40 miles the railroad lands were selected in 1886. These lands include alternate sections and probably comprise about one-half of the riparian lands. Prior to 1886 rights in the upper States amounting to 3,098.81 cubic feet per second had been acquired. For the next 20 miles east of Deuel County railroad lands were selected in 1890, and consequently have no riparian rights. For about 10 miles above the junction of the North and South Platte rivers the railroad lands were selected in 1874, and along the main stream east of the junction they were selected in the same year. Prior to 1874 rights to only 65.39 cubic feet per second had been acquired in Colorado and Wyoming. Throughout much of the distance between the State line and the city of Kearney on the main stream, below which are no irrigation ditches, much of the riparian land is swampy and therefore will make no demand on the stream. As with the South Platte, no estimate of the amount of water which can be claimed by riparian owners can be made, but in view of the fact that only a small part of the railroad lands were selected before 1886, and that a large part of them were selected after the passage of the law of 1889 abrogating riparian rights, and that settlement along the river began as late as 1883, prior to which many rights had accrued in Colorado and Wyoming, riparian rights on the North Platte may be considered of little importance from an interstate standpoint.

As has been previously pointed out, the use of the water along the North Platte in Colorado occurs chiefly in the flood season, when there is plenty of water throughout the course of the stream and natural conditions are such that this use can not be greatly enlarged. Throughout the greater part of the course of the stream in Wyoming there is practically no irrigation. The question of interstate rights between Wyoming and Nebraska, therefore, comes down to consider-

ation of the rights of ditches immediately above the State line in Wyoming and those in Nebraska.

The rights in Wyoming along this section of the river are, for the most part, subsequent to those in Nebraska, and a large part of those given in the table have not vested, but depend upon the completion of works and the use of water in accordance with the permits issued by the State engineer. The largest outstanding permits on this section of the North Platte in Wyoming are those of the Whalan Falls Canal Company and the Fort Laramie Canal and Reservoir Company. The former has a permit to divert water for 20,000 acres, the work to be completed in 1906. Some work has been done on this system, and the State engineer has authority to extend the time for the completion of works, so that it may be some years before the rights of this company are settled. The Fort Laramie Company has a permit, dated 1904, to divert water for 36,107 acres, the work to be completed in 1912. These two companies have pending rights which may equal more than 800 cubic feet per second, 300 of which can not be finally settled until 1906, and 500 of which can not be settled until 1912.

The rights of the ditches in Nebraska, as given in the table, were not finally determined, but were conditioned upon the completion of the works as planned at the time of the adjudication. (See p. 41.) Very few of these ditches has been completed, and their rights as given in the table are therefore largely in excess of their needs. The most striking example of this is the case of the Farmers' Canal, which has the second right on the stream and was granted conditionally 1,142.86 cubic feet per second, dating 1887. A decision of the supreme court in The Farmers' Irrigation District *v.* Frank[a] (see p. 41) has made this right absolute, except that it may be lost by abandonment. Not more than 2,000 acres have been irrigated by this ditch, and if its rights were cut down to the volume which has been beneficially used they would not exceed 30 cubic feet per second. The Gering ditch, which heads immediately below the State line, was given a conditional right to 500 cubic feet per second, while its maximum diversion in 1903 was 287 cubic feet per second, showing that its right, as given in the table, is nearly double the amount of water to which it can lay claim on the ground of use. But the use of water under this canal is being extended all the time, and it is probable that the right to the full volume can not be attacked on the ground of abandonment.

In both States the full volumes of the rights ultimately acquired by these companies will date from the filing of the applications, or the beginning of work where no applications were filed. It has been

[a] 100 N. W., 286.

shown (p. 24) that there is flowing in the North Platte at times more water than is required to supply all outstanding rights, but as a matter of fact it is seldom that there is not more than enough water to supply all existing demands. Plans are being made for the construction of new works to utilize this surplus by private parties and the Federal Government. But there is no way of telling from the present flow of the stream and present diversions what supply of water these new canals will receive. The enlargement of use under existing and pending rights may absorb all the surplus except in extreme floods.

A series of measurements of the North Platte and main Platte rivers, between the Colorado-Wyoming State line and the city of Kearney, Nebr., was made in the fall of 1903 by the agents of this Office to determine, so far as can be determined by a single series of measurements, the effect of diversions in the upper sections of the stream upon its flow farther down. These measurements are given in the following table:

Return seepage, North Platte River.

Section.	Length.	Gain (+) or loss (−).	Total gain (+) or loss (−) from upper station.
	Miles.	*Cubic feet per second.*	*Cubic feet per second.*
Colorado-Wyoming line to Douglas Creek	8.00	− 43.32	− 43.32
Douglas Creek to Sage Creek	52.00	−165.72	−209.04
Sage Creek to Fort Steele	22.00	− 41.12	−250.16
Fort Steele to Dickinson's ranch	21.00	+ 6.74	−243.42
Dickinson's ranch to Medicine Bow River	11.00	− 28.75	−272.17
Medicine Bow River to Sweetwater River	33.00	+ 9.58	−262.59
Sweetwater River to Alcova	12.00	+ 3.18	−269.41
Alcova to Delaware Springs	21.00	− 17.25	−276.66
Delaware Springs to Muddy Creek	36.00	+ 70.85	−205.81
Muddy Creek to Douglas	40.00	− 43.81	−249.62
Douglas to Horseshoe Creek	43.00	− 7.89	−257.51
Horseshoe Creek to Guernsey Canyon	16.00	+ 55.01	−202.50
Guernsey Canyon to Whalen	14.00	+ 7.37	−195.13
Whalen to Fort Laramie	6.00	− 10.48	−205.61
Fort Laramie to Rawhide Creek	9.00	+ 77.28	−128.33
Rawhide Creek to Torrington	8.00	− 76.90	−205.23
Torrington to Wyoming-Nebraska State line	12.00	+120.13	− 85.10
State line to Mitchell	14.00	+ 68.04	+ 68.04
Mitchell to Gering	10.50	+130.51	+198.55
Gering to Bayard	18.50	− 24.18	+174.37
Bayard to Bridgeport	13.30	+113.80	+288.17
Bridgeport to Oshkosh	45.50	− 69.47	+218.70
Oshkosh to Hayland Canal	30.00	− 51.20	+167.50
Hayland Canal to Paxton Bridge	24.00	+235.38	+402.88
Paxton Bridge to North Platte	34.00	− 22.35	+380.53
North Platte to Gothenburg	36.50	+109.76	+490.29
Gothenburg to Lexington	24.50	−164.79	+325.50
Lexington to Kearney	36.00	−209.62	+115.88

The course of the river throughout Wyoming is hard to follow, and the measurements were made at considerable intervals of time, leaving room for variations in the flow of the stream between the times of measurement. While the stream is more easily followed in Nebraska, Professor Stout, who made the measurements in that State, notes waves of increase and decrease during the progress of

FIG. 1.—NORTH PLATTE RIVER AT GUERNSEY CANYON—LOW WATER.

FIG. 2.—NORTH PLATTE RIVER NEAR DOUGLAS, SHOWING CHARACTER OF STREAM BED.

measurements, and attributes many of the changes to such waves rather than to return seepage. These waves are attributed to local precipitation, cloudy weather, which checks evaporation, or clear, windy weather, which greatly increases evaporation. The men making the measurements may overtake such waves or be overtaken by them in such a way that it is impossible to get any check upon their influence. It will be noted that throughout the entire portion of the stream measured there are alternating gains and losses in the flow. This may be attributed partly to the waves of increase and decrease mentioned above and partly to changes in the channel. The stream in some sections flows over solid rock, in others over beds of bowlders (Pl. IV, fig. 1), and in other sections winds back and forth over beds of deep sand (Pl. IV, fig. 2). Under such conditions varying portions of the water which is finding its way down the valley will be in the visible stream which is measured. The measurements should not, therefore, be given too much weight. Considering long sections of the river, the measurements through Wyoming show a net loss, while those between the Wyoming-Nebraska State line and Kearney show a net gain. It is not safe to base on these measurements any positive statements as to what would occur if conditions were different, but they seem to indicate that if ditches in Colorado or the upper sections of Wyoming were closed only a part of the water shut out of these ditches would reach Nebraska. Measurements in Nebraska seem to indicate that the closing of the ditches along the upper section of the stream within that State would increase the supply lower down as far as the vicinity of North Platte, below which there are large losses in the stream. The stream between North Platte and Kearney has from the earliest times gone dry in many years and been extremely low in every year, and it does not seem probable that the closing of the ditches above would noticeably increase the supply in the surface channel in this section of the river. The measurements of the water levels in wells, referred to on page 56, show that the water table for some distance north of the river has a slope to the south, which is not interrupted by the river, and indicate that water which passes into the sand in this section finds its way out of the valley of the Platte into the streams to the south. In the immediate vicinity of the Nebraska-Wyoming line there is a gain in the flow of the river, the notes of the measurements showing that in the section from Torrington to the State line the return seepage is almost exactly equal to the amount diverted in the section. There is prospect of large increase in the use of the water in this section immediately above the State line in Wyoming. The measurements seem to indicate that a large part of the water diverted in this section will return to the stream for use in Nebraska.

A large number of irrigators and ditch men in the vicinity of

North Platte and along the ditches below that city were interviewed, and none of them seemed to feel that diversions in the upper States diminished their supply of water. The general sentiment seemed to be that an increased use of water in Wyoming and along the upper valley in Nebraska would improve rather than injure the supply for the ditches below. The supply for these ditches has always been short in the late summer and could not be much worse. Their owners, therefore, look with favor upon the enlarged use of water above in flood season in the hope that the return seepage will maintain the flow below in the late summer.

From the above discussion it will be seen that there is little likelihood of any interstate conflicts on the North Platte unless it should be between ditches heading close together immediately above and below the State line. At present the Mitchell ditch heads just above the State line in Wyoming and carries water for use in Nebraska. The owners of this ditch have neither made an application nor filed a claim in either State. The Farmers' Canal and the Gering ditch head just below the State line, and surveys are being made for canals to head in the section above the State line. Contests have arisen between the Mitchell ditch and the other ditches, but the Mitchell ditch has so far been beyond control, since the Wyoming officials had no reason to close it to satisfy Nebraska ditches, and the Nebraska officials had no authority to close head gates in Wyoming. Some provision must in the future be made for controlling these head gates. Wyoming ditches above this point have no reason to complain, since they get the first chance at the water. All complaints will, therefore, come from Nebraska ditch owners, and the question is how to protect rights acquired in Nebraska against diversions in Wyoming.

It will be recalled that, regarding the South Platte, the conclusion was reached that the only probable conflicts would be between ditches immediately above and below the Colorado-Nebraska line.

INTERSTATE QUESTIONS.

The relations between rights on the same stream in adjoining States, or rather the interdependence of those rights, are not well defined. There is no legislation on this subject, either State or national, and few court decisions. In the State courts of Colorado but one decision even approaching this question has been rendered, and in that one decision [a] the court merely held that under the Colorado statute providing for the adjudication of water rights the district court was not authorized to determine rights to water to be diverted in Colorado for use in New Mexico. One of the ditches

[a] Lamson *v.* Vailes, 27 Colo., 201.

appearing in the adjudication has its point of diversion in Colorado, but extends beyond the boundary line and covers land in both Colorado and New Mexico. In the adjudication the ditch was denied any right for the land in New Mexico. The supreme court affirmed the decision on the ground that the lower court, under the special statute, had no jurisdiction to award any right for land outside the State. The court expressly disclaimed any consideration of the question whether the right for land in New Mexico would be protected in another action in the Colorado courts against subsequent appropriators in Colorado.

The question of the relation of rights on interstate streams was before the supreme court of Nebraska in Cline *v.* Stock.[a] Irrigation ditches in Nebraska had so used up the waters of the Republican River as to seriously interfere with its use for power by a Kansas mill owner who had used the water for power long prior to the construction of the irrigation ditches. It was contended by the defendants that the suit was an attack upon the sovereignty of Nebraska, and that the Kansas mill owner, being an appropriator outside the State, had no rights on the stream which the legislature of Nebraska must respect or might not authorize Nebraska citizens to disregard. In deciding against this contention the supreme court said:

> It would seem that the fact of the plaintiff's residence beyond the border of this State, and that his mill is located there, ought not to deprive him of any rights within the laws of our State given to a lower appropriator. Any attempt of our legislature to discriminate against him as compared with resident mill owners would be promptly declared unconstitutional by the Federal courts. It seems plain that the plaintiffs should be allowed the same standing as one of our own citizens with the mill on this side of the State line.

The same question has been considered by the supreme courts of Wyoming and Utah and by the United States courts for the district of Montana and Colorado. The Wyoming court held, in Willey *v.* Decker:[b]

> Under whatever system the right to appropriate water for irrigation is recognized, the natural and logical result of the doctrine would seem to be, at least in the case of interstate streams, and in the absence of contrary constitutional and statutory provisions, that the separation of the lands capable of irrigation from such streams by State lines is of no consequence if we are to consider merely the general principles of the doctrine and the reasons that called it into existence. The same necessity applies to the lands on either side of the line, and the water naturally flows in the channel of the stream in disregard of such line above as well as below it.

The Utah supreme court, in Conant *v.* Deep Creek Irrigation Company,[c] held:

> It is a recognized rule of law that a person who has appropriated water to a certain point in a stream is entitled to have so much of the waters of said stream as he has appropriated flow down to him to the point of his diversion,

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[a] 98 N. W., 454. [b] 73 Pac., 210. [c] 66 Pac., 188.

and if the settlers higher up on the stream in another State, whose appropriations are subsequent, divert any of the waters of the stream which have been so first appropriated, then the courts of the latter State will protect the first settler in his rights.

The United States court for the district of Montana, in Howell *v.* Johnson,[a] held:

Appropriators of water from interstate streams are entitled to protection against injury by later appropriators, in accordance with the doctrine of prior appropriation, regardless of State lines.

The same principle is announced by the United States court for the district of Colorado, in Hoge *v.* Eaton,[b] in which the court held:

The right to divert running waters for irrigating lands in an arid country is not controlled or affected by political divisions. It is the same in all States through which the stream so diverted may pass.

An appropriation of water in the State of Wyoming from a stream which rises in Colorado for irrigating lands in Wyoming is valid as against a subsequent appropriation in Colorado from the same stream for irrigating lands in Colorado.

There are, so far as the writer has been able to find, no decisions denying the rights of appropriators in the lower State protection against injury by later appropriators in the upper State, while the decisions quoted above are all in favor of such protection.

The supreme court of Colorado has held repeatedly that the right to divert water from the streams of that State arises from necessity, not from the statutes of the State, and would still exist if the statutes were repealed.[c]

The supreme court of Nebraska, in Crawford *v.* Hathaway,[d] is committed to this same doctrine as regards the right in Nebraska.

In our view of the subject, rights of appropriators of water, who have applied the same to the soil for agricultural purposes by means of irrigating canals, antedates the passage of either of the irrigation acts of the legislature of which we have just made mention. This right has grown out of the necessities of the case, and has been sanctioned by the acts of Congress and recognized by the laws of the State.

Other States are also committed to the same doctrine as to the origin of the right of appropriation. The Wyoming court, in Moyer *v.* Preston,[e] says:

Irrigation and reclamation can not be accomplished with any degree of success or permanency without the right to divert and appropriate water of the natural streams for that purpose and the security accorded to that right. The imperative and growing necessity of our condition in this respect alone * * * compel the recognition rather than the adoption of the law of prior appropriation.

It is thus seen that the generally accepted doctrine in the three States through which the Platte rivers flow is that rights are based

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[a] 89 Fed., 556.
[b] 135 Fed., 411.
[c] Yunkers *v.* Nichols, 1 Colo., 570.
[d] 93 N. W., 781.
[e] 44 Pac., 845.

on the necessities of using water and not on their statutes. The necessity exists regardless of State lines, and therefore the rights should be protected regardless of State lines.

PROTECTION OF RIGHTS IN A LOWER STATE AGAINST DIVERSIONS IN AN UPPER STATE.

In the case of Cline *v.* Stock, cited above, it was contended by the Nebraska ditch owners that the suit was an attack upon the sovereignty of Nebraska, and that the Kansas mill owner, being an appropriator outside the State, had no rights in the stream which the legislature of Nebraska must respect or might not authorize Nebraska citizens to disregard. The supreme court decided against this contention. The case was remanded to the lower court for a determination of the rights. In this case the Nebraska court declares that the rights of an appropriator in the lower State must be protected by the courts of Nebraska.

The same question is treated exhaustively by the supreme court of Wyoming in the case of Willey *v.* Decker.[a] In that case the Wyoming court, after declaring that rights by appropriation are good regardless of State lines, proceeds to consider the remedies which are available to the appropriator in the lower State. The stream in question rises in Montana and flows into Wyoming, but one of the ditches in contention diverts water in Wyoming for supplying lands in both Wyoming and Montana. In the one case, therefore, the question of the power of Wyoming courts to protect rights in Wyoming against diversions in Montana and rights in Montana against diversions in Wyoming is presented. On the question of the jurisdiction of the Wyoming courts to protect appropriators in Wyoming against diversions in Montana, after citing a long list of authorities, the court says:

> On principle and authority, therefore, we think there can be no doubt of the jurisdiction of the district court [Sheridan County, Wyo.] to render a decree restraining defendants Demmon from diverting the waters of the stream in Montana to such an extent as to deprive those plaintiffs whose lands are situated in this State [Wyoming] of the water to which they are found to be entitled by priority of appropriation.

As to the question of the power of the Wyoming court to protect appropriators in Montana against diversions in Wyoming, the court says:

> The rights of plaintiffs Willey and Ellison (whose lands are located in Montana), therefore, if they be found entitled by priority of appropriation, upon the facts, to the use of water as against any appropriation of defendants, include the right to have the water of the stream flow down to the head gate

[a] 73 Pac., 210.

of the ditch. An injury occurs to their rights if that flow be prevented. It follows that they suffer an injury within this State through the diversion of defendants at points above the head gates of Gladewater ditch.[a]

As regards the distribution of the North Platte River between ditches in Wyoming and Nebraska, therefore, the above citations show that both States are committed to the doctrine that an appropriator in the lower State may secure protection against diversions in the upper State in the courts of the upper State, while the Wyoming court holds that diversions in the upper State can be restrained by the courts of the lower State.

The same doctrine as to the courts of the upper State has been announced by the supreme court of Utah in the case of Conant *v.* Deep Creek and Curlew Valley Irrigation Company,[b] and the district court of Idaho assumed jurisdiction over an interstate stream in the case referred to in the Utah case just cited. In this case the Utah court says:

It is a recognized rule of law that a person who has appropriated water at a certain point in a stream is entitled to have so much of the waters of the said stream as he has appropriated flow down to him to the point of his diversion, and if the settlers higher up on the stream in another State whose appropriations are subsequent, divert any of the waters of the stream which have been so appropriated then the courts of the latter State will protect the first settler in his rights. The Idaho courts, therefore, have ample and complete jurisdiction to protect the rights of respondents to have the waters which they have appropriated and which they divert in Utah flow through the channel of the stream and to limit and determine the rights of the Idaho appropriators with reference thereto; and by the decree entered in the suit in the district court of Oneida County, Idaho, such rights were fully protected and may be enforced by proper proceedings in that court.

It has been contended that an appropriator would not receive justice in the courts of another State, but it will be noted that in each of the decisions quoted, except the Utah case, the decision was rendered in the State whose citizens would be deprived of water by the enforcement of the decision.

In the case of Hodge *v.* Eaton[c] the Federal district court granted an injunction restraining diversions from Sand Creek in Colorado to the injury of prior appropriators in Wyoming.

Each of the States through which the Platte River flows has recognized, however, that an appeal to the courts every time a ditch owner does not receive what he considers his proper supply of water is an expensive remedy. Referring to the disadvantages of leaving such matters entirely to the courts, the Wyoming court in Willey *v.* Decker[a] says:

It is evident, however, that one irrigating lands in another State must suffer some disadvantages. The State laws regulating the distribution of water can

[a] 73 Pac., 210. [b] 66 Pac., 188. [c] 135 Fed., 411.

not operate beyond its boundaries, and it is doubtful whether any remedy in case of injury to his rights is open to such an appropriator other than those obtainable through the medium of the courts.

To avoid such litigation within its own limits each of these States has provided an administrative system, with officials to distribute water to the ditch owners according to their rights as determined by the courts or the boards of the States.

If the flow of a stream were constant a ditch in an upper State might be permanently closed by injunction, and the single suit would serve to protect the rights of the lower appropriator; but the flow of the stream varies from day to day, so that the diversion by the upper ditch might one day injure a lower appropriator and another day leave sufficient water in the stream to satisfy his rights, and his right is only to have a certain volume of water flow down to him. Under such circumstances, in the absence of any official whose duty it is to regulate head gates, it would be necessary for the lower appropriator to resort to the court every time his right was infringed, and a multiplicity of suits would result. Therefore, protection of the rights of the lower appropriator in the courts of the upper State, while adequate, is not satisfactory, and there is need for some system similar to the administrative systems adopted by each of the three States, Colorado, Wyoming, and Nebraska. In Colorado the common practice is for the superintendent of a water division to order the commissioner of an upper district to close the ditches whose rights are later than those in a lower district which are not receiving their full supply. This entails no expense, and the only formality required is to notify the superintendent of the shortage of water in the lower district. Under a similar system with interstate powers, the official having general charge of the distribution of water would have a complete table of priorities for the several States, and when notified by the lower ditch owners that they were not receiving their full supply of water would order closed later ditches in the upper State. This can be provided for in several ways. It has been proposed that the General Government appoint, under proper legislation, an interstate irrigation commission, to which all interstate questions shall be referred. This proposed commission is not to supersede State officials, but to issue orders to the State engineers to turn down interstate streams the water which belongs to parties in a lower State, just as in Colorado a division engineer orders the water commissioner of one district to turn water down to a lower district. It is also proposed that a similar commission be provided for by compact between the interested States.

WATER-RIGHT SYSTEMS.

In the preceding discussion the nature of water rights has been discussed only in a limited way, and the attempt has been to show what rights exist in the different States and to define their relation to each other. It seems desirable to go further and discuss the general subject of water rights in the Platte watershed in their relation to social conditions and the best use of the water supply. Preliminary to this discussion is a statement of the nature of the rights in the three States as defined by legislation and court decrees.

COLORADO.

The first Territorial legislature of Colorado provided for the acquirement of water rights by appropriation, and the Territorial supreme court declared that the right existed prior to legislation on the subject.[a] The right of appropriation, therefore, is not based on legislation, but on natural conditions. The constitution of the State carries this same idea, by not providing for the acquirement of rights by appropriation, but stating that "the right to divert the unappropriated waters of any natural stream for beneficial uses shall never be denied."

The right of appropriation is therefore a natural right, which the people of the State, in the adoption of their constitution, recognized but did not create. This position is further borne out by decisions of the supreme court of the State,[b] in which the court held that the legislation of the State on this subject was in exercise of its police power.

The nature of the legislation of the State shows the same thing. It is confined to providing the procedure for defining rights—not granting them—and the procedure and officials for enforcing and protecting rights.

The laws of the State recognize no riparian rights and the supreme court of the State has held that the doctrine of riparian rights has no application to Colorado streams, because of natural conditions, which require that the water of streams be diverted.[c]

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[a] The right to water in this country by priority of appropriation thereof we think it is and always has been the duty of the National and State governments to protect. The right itself, and the obligation to protect it, existed prior to legislation on the subject. (Coffin *v.* Left Hand Ditch Company, 6 Colo., 443.)

[b] This court held that our so-called irrigation statutes for the ascertainment of priorities, and placing the distribution of water for irrigation purposes under control of State offices, are constitutional, though they affect rights which accrued before the enactments were made and place upon their enjoyment limitations from which they were theretofore exempt. These statutes are upheld as a rightful exercise of the police power of the State. (New Cache la Poudre Irrigation Company *v.* Water Supply and Storage Company, 29 Colo., 469.)

[c] Oppenlander *v.* Left Hand Ditch Company, 18 Colo., 142.

Since the right to appropriate water grew out of climatic conditions rather than legislation, the nature of the rights acquired and the limitations upon them were not well defined, and the constitution and laws of the State have left them largely undefined. Consequently the courts of the State have been free to limit rights as they saw fit, and court decisions must be looked to for the nature of water rights. The most far-reaching ruling regarding water rights in Colorado is that they may be sold and transferred independently of the land on which the water has been used.[a]

That is, it is not a right to enough water for a described area of land, but a right to a definite volume of water, which may be sold and transferred to any land that can be reached, provided no one is injured by the transfer. Until 1901 no procedure for making transfers was prescribed, and parties claiming to be injured were obliged to bring suit to prevent the transfer. In 1903 a law was enacted providing that parties wishing to change the place of diversion or use of water must apply to the court for permission to make the change. On such application being made a hearing similar to an adjudication is held, and all parties interested may be heard for or against the transfer, and it can be made only on approval by the court after such a hearing.

Without exception the decrees in the districts including the South Platte and its tributaries confirm to the various ditches rights to definite volumes based, in some instances, on the measured or estimated capacities of the ditches, in others on the statements of the interested parties as to what they had used, and in others computed from the area said to have been irrigated. These rights are held to be absolute even if the computations made in compiling the decree are shown to have been wrong.[b] The right is to a continuous flow of the volume stated.

Although an adjudicated right can not be questioned after the expiration of the statutory period for appeal, it may be lost by abandonment. If a party does not make use of the volumes of water decreed the right will be open to attack on this ground and may then be cut down to the volume which has been put to beneficial use.

WYOMING.

Wyoming was organized as a Territory in 1868. Prior to this there was almost no settlement and practically no agriculture. The

[a] A priority of right to the use of water for irrigation is a property right, and may be sold and transferred separately from the land in connection with which it ripened. (Strickler *v.* Colorado Springs, 26 Pac., 313.)

[b] Boulder and Weld Ditch Company *v.* Lower Boulder Ditch Company, 22 Colo., 115.

first legislature adopted the common law of England so far as it was "not inapplicable." The supreme court of the State has held that this enactment did not establish the doctrine of riparian rights in Wyoming, as that doctrine is considered inapplicable.[a]

With the admission of Wyoming as a State, in 1890, an entirely new code of water laws was adopted. The constitution declared that all unappropriated water was the property of the State, and that rights to its use could be acquired by appropriation. Laws were enacted which limited the right of appropriation and required any party wishing to divert water to make application to the State engineer and receive a permit before construction began. This permit is not a deed to water, but merely gives the applicant the right to proceed with the construction of works and the diversion of water in accordance with the terms of the permit.

None of the Territorial laws regarding water rights defined them in any way. Under these laws there was no litigation and consequently no court decisions setting forth the nature of rights to water. The law of 1886 required the filing of statements giving the date of construction, capacity of works, amount of the water claimed to be appropriated, the number of acres "lying under and being or proposed to be irrigated" by the works. The law contains nothing which would give any indication as to which of these conditions was to govern the volume of the right. Only a few adjudications took place under the law of 1886. The first of these was to determine the rights on Bear Creek. The decree awarded definite quantities of water to the parties to the adjudication, only a few of those using water from the stream appearing. The court in this case apparently considered that the parties had rights to definite quantities of water. The decree defining rights to Crow Creek awarded to each party sufficient water for a definite area of land, not to exceed a fixed volume. No uniform rule was observed in fixing this maximum volume which could be used and no ditches were named. The rights would therefore seem to have been considered as not attached to any particular areas, but they did not entitle their holders to fixed quantities of water, but rather to sufficient water for definite areas of land. The decree defining the rights to Horse Creek is similar to that on Crow Creek,

[a] The common-law doctrine relating to the rights of a riparian proprietor in the water of a natural stream and the use thereof is unsuited to our requirements and necessities and never obtained in Wyoming. * * * A different principle, better adapted to the material conditions of this region, has been recognized. The principle, briefly stated, is that the right to the use of water for beneficial purposes depends upon a prior appropriation. We incline strongly to the view expressed by the supreme court of Colorado to the effect that such right and the obligation to protect it existed anterior to any legislation on the subject. (Moyer *v.* Preston, 6 Wyo., 308.)

except that the ditches are named. This would not, however, change the nature of the right.

The same principle, that is, that the appropriator is entitled to enough water for a specified area, is contained in the law adopted in 1890. There is, however, the limitation that this use shall not exceed 1 cubic foot per second for 70 acres. The board of control has uniformly held that the rights acquired since 1890 are attached to particular tracts of land. This ruling has, however, been reversed by the supreme court of the State in the recent case of Johnston *v.* Little Horse Creek Irrigating Company.[a] A ditch company which had been awarded a right by the board of control sold a half interest in the right awarded to it, and a third party, whose rights were later than those of the seller but acquired prior to the sale, attacked the transfer on the ground that under the laws of Wyoming a water right is attached to the land and can not be transferred apart from the land. Regarding this contention the court says:

> We are aware that notwithstanding the expressions and decisions in the cases above mentioned, which decisions were rendered in 1894, prior to the execution of the deed in question, there has existed in the minds of the administrative officers of the State charged with the execution of the laws governing the appropriation and distribution of water an opinion that, by reason of some provisions of our statutes, unlike the statutory provisions prevailing in most of the other arid States, water appropriated for the irrigation of land becomes not only appurtenant thereto, but inseparably connected therewith, and therefore incapable of transfer or conveyance separate from the land; and the opinion, we understand, has prevailed among such officers that in the cases aforesaid the effect of our peculiar statutory provisions was not considered. In view of the fact that such decisions were rendered before the conveyance in question, and that the parties presumably relied thereon in granting and receiving the conveyance, the law ought to be found very clear to justify the court at this time in overruling them and holding the transfer void.
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> It is not denied, nor can it be, that it has uniformly been held in this country, wherever the doctrine of prior appropriation is recognized, that a water right obtained by and for the irrigation of land may be sold separate therefrom. (Gould on Waters, sec. 234; Kinney on Irr., secs. 264, 265, and cases cited; Long on Irr., sec. 79; 3 Farnham on Water and Water Rights, secs. 643, 679.) Mr. Farnham says, in section 679 of his work, above cited: "The right acquired by an appropriation of water being a property right, it is subject to transfer the same as any other species of property; and this transfer may be separate from the land upon which it was intended to be used. And this sale may include all of the right to which the vendor is entitled, or it may be limited to a portion of it." And in section 643 the same author says: "But there is no reason why it should remain attached to the land in connection with which it was first used, and therefore the rule is that it may be sold separate from the land."
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> As an appropriator of water obtains by his appropriation that only of which he makes a beneficial use, it necessarily follows that he can not sell surplus water which he does not need, while retaining his original appropriation, and

[a] 79 Pac., 22.

it has been held that, as against a subsequent appropriator, a senior appropriator can not give the water he does not use to another for a certain period, who otherwise would have no right to use it. (Manning *v.* Fife (Utah), 54 Pac., 113.) So far as we are informed, however, every case in which that or a similar principle has been decided admits that the water right may be sold and conveyed separate from the land, provided other appropriators are not injuriously affected by such sale.

An individual appropriator of water for irrigation secures no surplus water; hence he has no surplus which he can either sell or give to another, as against subsequent appropriations. His appropriation, and therefore his water right dependent thereon, is at all times limited, within the maximum of his appropriation, to the quantity capable of beneficial use and actually so used. If during any period he does not require the use of the water, it falls during that period to the subsequent appropriator who does need the same and can beneficially use it. What the appropriator may sell is his water right. That is all he has to sell. That is all that would pass by deed of the land as an appurtenance. The water in the stream is not his property, but his right to use that water, based upon his prior appropriation for beneficial purposes, is a property right, and, as such, is capable of transfer. The only limitation upon the right of sale of a water right separate from the land to which it was first applied, and to which it has become appurtenant, laid down by any of the authorities, is that it shall not injuriously affect the rights of other appropriators. In other words, the burden upon the use must not be enlarged beyond that which rested upon it under the original appropriation, and while in the hands of the original appropriator as he was entitled to and did use it. This principle is the necessary result of the fact that the only property in the water owned by the appropriator is a right to use it as measured by his appropriation.

NEBRASKA.

The Territory of Nebraska adopted "so much of the common law of England as is applicable and not inconsistent with the Constitution of the United States, with the organic law of this Territory, or with any law passed or to be passed by the legislature." This left the question as to whether the Territory adopted the common-law rule as to riparian rights unsettled and depending on the applicability of the rule. This question was not finally decided until the rendering of the decree in Crawford Company *v.* Hathaway [a] in 1903. The court held that the rule was adopted and remained in force until abrogated by statute.

The first legislation of the State referring to irrigation was the act of 1877, which extended to irrigation canals the provisions of the laws relating to internal improvements. This empowered canal companies to issue bonds and condemn rights of way for canals. It made no mention of the right to take water from streams to fill these canals, and the court held that this law did not abrogate the rule as to riparian rights. Consequently, whatever rights were acquired rested on custom rather than legislation and were subject to riparian rights previously acquired.

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[a] 93 N. W., 791.

Under the act of Congress of 1866, recognizing rights acquired by appropriations made in accordance with local laws, customs, or decisions, and making all public land thereafter disposed of subject to such rights, rights acquired by appropriation in Nebraska are held to be superior to riparian rights attaching to lands acquired from the Government after the appropriations were made.

No further irrigation legislation was enacted until 1889. In that year a law was enacted providing that rights to water from the streams, etc., of the State might be acquired by appropriation, priority giving the better rights as between appropriators. The water must be taken for a beneficial use, and when the use ceases the right ceases. Parties who had made diversions prior to the passage of this law were held to have acquired rights to water equal to the capacities of their ditches, but in no case exceeding the quantity claimed. This law is held to have abrogated the common-law rule, and lands acquired from the United States Government since its passage have no riparian rights. In regard to rights acquired by appropriation and by the ownership of riparian lands prior to the enactment of the law of 1889, the court says:

> The two doctrines stand side by side. They do not necessarily overthrow each other, but one supplements the other. The riparian owner acquires title to his usufructuary interest in the water when he appropriates the land to which it is an incident, and when the right is once vested it can not be divested, except by some established rule of law. The appropriator acquires title by apropriation and application to some beneficial use and of which he can not be deprived, except in some of the modes prescribed by law. The time when either right accrues must determine the superiority of title as between conflicting claimants. (Crawford Company *v.* Hathaway, 93 N. W., 791.)

That is, a right acquired by appropriation prior to 1889 is subject to the rights of riparian lands acquired from the Government prior to the appropriations, and riparian rights are subject to all rights acquired by appropriation made prior to the acquirement of the lands from the Government. Rights obtained by appropriation since 1889 are subject to the riparian rights attaching to lands acquired from the Government prior to that year. The nature and limitations of the water rights of riparian proprietors are fully brought out in the case cited. This decision is discussed by Mr. Dunton as follows:

> By the doctrine of Crawford *v.* Hathaway the rights of a riparian owner, to which he acquires title when he secures the land on the banks of a stream, consist in the right to use the waters of the stream for domestic purposes, such as drinking and cooking and watering stock, and also in the right to a reasonable use of such waters for purposes of irrigation. "This right of a riparian owner as such to the use of water for irrigation is limited to riparian lands. The right can not be extended to lands contiguous to the riparian land, nor can water be diverted to nonriparian lands which might be used on riparian lands, but is not. Land to be riparian must have the stream flowing over

it or along its borders." Its extent can not in any event exceed the area acquired by a single entry or purchase from the Government, and the court was strongly inclined to hold that such area should be restricted to the smallest subdivision of a section—that is, 40 acres—or, in case of irregular tracts, a designated, numbered lot in the Government survey, bordering on the stream. "This is not to be taken, however, as meaning that every riparian owner may claim the benefit of the stream for the purposes of a tract of that size in every case. It is to be taken as a limitation of the reasonable use permitted by law rather than as defining it. In case the size of the stream, the amount of water therein, and the number of riparian owners who may make use thereof are such that the irrigation of 5 acres, for example, would be an unreasonable use, the riparian owner would not be permitted to use water to that extent in derogation of rights of other riparian owners, and in consequence could not claim damages against an appropriator on that basis. (McCook Irrigation and Water Power Company *v.* Crews, 97 N. W.)

For infringement upon his rights the riparian owner can not enjoin an irrigation enterprise by an upper appropriator, nor can he do so even though his damages for injury to his riparian rights have not been paid. His only remedy is to sue the irrigator for damages. The mere fact that he is deprived of the full flow of the stream adjacent to his land would furnish no basis for such damages. "Merely diminishing the volume of water in the stream would not deprive the owner of property for which he could lay claim to a pecuniary compensation." In order to entitle him to compensation he must suffer an actual loss or injury to his riparian rights as above defined, which will materially depreciate the value of the land to which such rights are attached.

One phase of the question of riparian rights was considered, but not decided, in Crawford *v.* Hathaway, which is of especial importance in considering the Platte rivers. The court states that "as to those streams of water flowing through the State which may be classed as interstate rivers, and along the banks of which meander lines have been run by the Government in its survey of public lands, the question is left open as to whether or not the waters of such streams may not be treated as waters of navigable rivers and to which riparian rights of an adjoining landowner would not attach as against the right of the public to use the waters thereof by its appropriations and application to beneficial purposes." The Platte River is essentially an interstate river. Both it and its branches—the North Platte and the South Platte—are meandered streams, and should the further decisions of the court affirm the above doctrine, to which Chief Justice Holcomb seemed inclined, the question of riparian rights would be entirely removed from any controversies over water rights from the Plattes.

Regarding water rights acquired by appropriation and use prior to its passage, the law of 1889 provides that the owners of ditches should be held to have rights to the capacities of their works, but not exceeding the amounts claimed, and that the place of use might be changed if others were not injured by the change. Under this law, then, the water-right holder had a right to a fixed quantity, which was not attached to the land, since he could change the place of use and sell the water apart from the land or sell the surplus not needed for his own land. The only limitation was that it must be put to beneficial use and kept in use or the right would lapse.

Under the law of 1895 rights are acquired, as in Wyoming, by

applying to the State board of irrigation, building a ditch, and using water, and the holder has a right to sufficient water to irrigate his land, not to exceed 1 cubic foot per second for 70 acres. This right attaches to the land for which the application was made and approved by the board, and the water can be used on no other land. The right, therefore, belongs to the land, not to the individual, and can not be disposed of apart from the land. The right is to sufficient water for the particular tract, within the limit of 1 cubic foot per second for 70 acres, and not to a fixed quantity. If the full quantity is not needed for this land it remains in the stream and goes to supply later rights, instead of being sold by the holder of the earlier right.

From the foregoing statement it appears that in each of the States in which the Platte rivers extend rights have been acquired by appropriation; that water must be put to a beneficial use; that among appropriators the first in time is the first in right; and that in Colorado and Wyoming rights may be transferred from one tract of land to another, if others are not injured by the transfer.

ACQUIREMENT OF RIGHTS BY APPROPRIATION.

The right to appropriate water from streams is usually considered in its opposition to the common-law doctrine of riparian rights. But the doctrine of riparian rights is so manifestly unsuited to the conditions of the arid region and the diversion of water from streams is so essential to any considerable development of that region that it is not considered necessary to discuss appropriation in that light. Assuming that the water must be diverted from the streams in order that the country may be developed, and that its diversion is, therefore, justifiable, two systems of acquiring rights are possible—appropriation and grant or license.

A system of grant or license requires that the water belong to the public, as it does, and that the State or nation allow its use only on the receipt of a grant from the authority controlling it. The most evident advantage of such a system is that there is always a complete record of rights and that rights will always be well defined, since they will be limited by the terms of the grants. On the other hand, the most evident disadvantage of a system of appropriation is that there is no complete record of rights and the nature and limitations of rights are not defined. This has been the greatest evil of this system in its operation in the arid section of the United States. Canals were built and water used without any record of what was done. This process went on until there was not water enough for all. The principle of priority was generally recognized, but there were no records to show whose rights were prior, and where this was well

known there were no commonly accepted rules as to the limits of the rights of appropriators. Uncertainty as to these points has led to litigation, which has been the greatest burden on the water users of the West.

Various attempts, none of them successful, to provide for records of appropriations have been made. The most common is a requirement that the party desiring to appropriate water must post a notice of the intended appropriation at the proposed point of diversion and file a copy of this notice with some public official, the notice to state fully the intentions of the claimant. Colorado now has such a law, and Wyoming and Nebraska have had them in the past. Their weakness lies in the fact that there is no limit on what may be claimed, and no public inspection of the work done to see that the water claimed has been diverted and used. As a result there are hundreds of claims on file with no record whatever to show whether the appropriations were ever completed. The records are, therefore, valueless as showing what rights exist, and they do not, of course, show anything as to the nature or limitations of rights. It is possible to enact laws defining exactly the nature of rights and providing for inspection of claims filed and works built and the recording of the results of such inspection, which, if properly enforced, might do away with the evils which have so far attended the acquiring of rights by appropriation, but the experiment has never been tried.

Wyoming and Nebraska have, however, gone further than the course suggested and adopted what amounts to a system of license, although the word "appropriation" is still retained in their laws. Under these laws the intending water user must make application to the State engineer, stating what his plans are, and before construction may begin this application must be approved, and it may be rejected if its approval is contrary to the public interests. The approved applications state the time within which the works must be completed, and the laws provide for the submission of proof of completion and for inspection of the works by public officials. After such proof and inspection, certificates are issued defining exactly the rights which have been acquired. The Wyoming law was enacted in 1890 and the Nebraska law in 1895, and there has been little litigation regarding rights initiated since these laws went into effect.

TRANSFERS OF WATER RIGHTS.

Colorado has provided by law for transfers, with the restriction that others shall not be injured. The board of control in Wyoming has uniformly held that transfers could not be made, but has been overruled by the supreme court of the State,[a] while the Nebraska

[a] Johnston *v.* Little Horse Creek Irrigation Company, 79 Pac., 22. See p. 83.

supreme court has followed the Wyoming board of control in holding that water rights can not be transferred. The most immediate effect of the ruling that transfers can be made in Wyoming was to destroy the value of the records of the State engineer's office as a guide for the distribution of water by the State officials, since there was no provision for recording transfers; but a law providing for such records was at once enacted.

A careful distinction should be drawn between transfers of rights from one piece of land to another and transfers which permit the holding of rights apart from any land and the sale of the water obtained on such rights. Against transfers of the first class there is no objection if they are safeguarded by such restrictions and public supervision as will insure that there is no enlargement in the demand upon the supply to the detriment of other rights, and if the diversion of the water at the new point does not lessen the supply for others. For example, the transfer of a right from the lower end of a stream where it is supplied by return seepage to the upper end of the stream where the water diverted would come from the natural supply of the stream might mean the taking of water away from others to their injury, while a transfer from the upper to the lower end of a stream might result in a decreased demand on the stream on account of return seepage or an increased demand on account of losses rather than gains in the channel of the stream.

Against transfers which permit of the ownership of water rights apart from land the fundamental objection is that it makes possible a monopoly of the water supply, which may lead to extortion. To guard against this throughout the arid region the use of water in irrigation is declared to be a public use, making it subject to public control, and giving to the public the right to regulate rates. The constitution of Colorado provides that the rates which may be charged for water may be fixed by the county commissioners of the various counties. Wyoming had such a statute until 1903, and the supreme court of Nebraska has held that in that State the law may interpose to prevent the collection of unreasonable rates, although there is at present no statutory provision for such regulation.[a] There is, however, very little water sold or rented by ditch companies in the Platte valleys. In Colorado more than 85 per cent of the land watered by the Platte rivers is served by ditches owned either by the individual farmers using the water, by partnerships of such farmers, or by stock companies, the stock of which is principally in the hands of the farmers, notwithstanding the fact that irrigation has been practiced there for almost fifty years, and the right of transfer has always existed. In Colorado the present tendency is away from the

[a] Frank *v.* Farmers' Irrigation District, 100 N. W., 286.

ownership of ditches for the sale of water, and irrigation districts are being organized to buy out the ditches, and a bill providing that such districts might condemn the ditches watering the lands of the districts was introduced in the Nebraska legislature in 1905, but was not enacted.

Although there are few companies selling or renting water in the Platte valleys, there is an indeterminate amount of such traffic by individuals owning stock in ditch companies. The prevailing form of ditch company is the stock company, the stock entitling its holder to a share of whatever water the ditch furnishes. The stock of these companies may be bought and sold, and the water used on any land which can be reached by the ditches. The expenses of maintenance and operation are usually met by assessments on the stock, and the companies neither sell nor rent water, and consequently have no rates which can be regulated. The individual stockholders sell or rent their stock, and the rentals do not come within the provisions of the Colorado law. This practice is not uncommon, and in the North Platte Valley in Nebraska promoters of a sugar factory have secured control of several ditches by buying a majority of their stock. In Nebraska, however, stock ditch companies cover expenses by charging for water[a] rather than by assessments on stock, and it may be that these charges would be subject to regulation by law. If not, these promoters, owning a majority of the stock of the companies, can regulate charges to suit themselves. In fact, the claim that they can do this is used to bear the price of land to aid them in buying it up. To be effective, therefore, in preventing extortion, the laws relating to the fixing of rates must be extended to control rentals of ditch stock in Colorado and rates charged for water in Nebraska by companies originally organized to supply water to their stockholders, the stock of which has passed out of the hands of the water users.

BENEFICIAL USE.

Where rights to water are acquired by appropriation, the appropriation must be for beneficial use, and, logically, the rights are limited by the beneficial use made. Under the doctrine of priority the party having made a beneficial use of water is entitled to continue that use as against anyone having subsequently taken water from the same source. Abstract justice to the subsequent appropriator requires that the use of water by the prior appropriator be such as to maintain conditions as they were at the time the subsequent appropriation was made, in so far as any change in conditions would affect the continuation of the use to which the water had been put by the later

[a] Enterprise Company *v.* Moffitt, 58 Nebr., 642.

appropriator. That is, the right of an appropriator at any time would be limited to the right to continue the beneficial use which he had made up to that time, and any enlarged use or different use would be later and therefore subject to any rights acquired by others in the meantime. This would be the logical result of basing rights absolutely on beneficial use, and this principle is at the foundation of water rights in the Platte Valley, although it is very much obscured by modifications adopted in applying it.

It would be extremely difficult to make and enforce a table of priorities showing just when each enlargement in use by each appropriator took place. Under existing practice a single appropriator may have two or three or more rights with different priorities, but if each canal had a separate priority for each piece of land as it was brought under cultivation, and if for each piece of land there was a series of rights with different dates, as the character of the crops grown and therefore the time of use and quantity used changed the distribution of the water of a stream in accordance with those rights would be so intricate and burdensome that the water would be hardly worth the cost of distribution. This has been avoided by basing rights on original construction and subsequent enlargements of works. In Colorado the right is dated at the time of beginning construction, the measure of the right being the carrying capacity of the works, provided the water is put to a beneficial use within a reasonable time. In Wyoming and Nebraska the measure of the right is the need of the area of land for which an application is approved by the State engineer, and the time within which the water must be put to the beneficial use is fixed in the approval of the application. If the water is put to use within a reasonable time in Colorado, and within the prescribed time in the other States, the right to the whole volume dates from the first step in its acquirement. This is known as the right of relation, and is a modification of the principle of beneficial use, made necessary in putting that principle into practice.

The doctrine of relation has, however, a much more important bearing. It is necessary to the construction of large works, since without it there would be no assurance that when such works are completed there will be any water left in the source of supply. Other ditches begun later might be rushed to completion and the water all diverted, making whatever had been expended on the first ditch a total loss. Without this modification of the principle of beneficial use it is doubtful whether any large canals would be built. Canals are usually built to water land previously uninhabited; a company building a large canal can not get settlers for all its lands at once. This must necessarily be a slow process, taking in some cases many years. Theoretically, the application of the water to land is necessary to the acquirement of the right, and the question of what is

reasonable diligence in securing settlers to make such application is hard to answer. The courts of Colorado have avoided it by ignoring it entirely (see pp. 26–36) and decreeing rights usually on the basis of the estimated capacities of the ditches or on the areas under the ditches, dating the right to the full amount on the date of construction, regardless of when the water was finally put to use or whether it has ever been used. In doing this the Colorado courts are, however, clearly within the law, since the statute providing for the adjudication of water rights directs the courts to—

> * * * make and cause to be entered a decree determining and establishing the several priorities of right, by appropriation of water, of the several ditches, canals, and reservoirs in such water district, concerning which testimony shall have been offered, each according to the time of its said construction and enlargements, or extensions, with the amount of water which shall be held to have been appropriated by such construction and enlargements, or extensions, describing such amount by cubic feet per second of time, if the evidence shall show sufficient data to ascertain such cubic feet, and if not, by width, depth, and grade, and such other descriptions as will most certainly and conveniently show the amount of water intended as the capacity of such ditch, canal, or reservoir, in such decree. (Mills Ann. Stat., sec. 2403.)

The courts of Colorado have repeatedly held that the application of the water to a beneficial use was necessary to the acquirement of a right,[a] and these decrees are, therefore, not final. The status of rights thus decreed is brought out by Justice Campbell, of the supreme court of Colorado, in two cases decided in 1895.[b] In the first case a ditch was awarded a right in excess of its use and did not after the decree use the surplus, but after several years attempted to transfer it. In the second case it was alleged that a ditch was awarded more water than it had used up to that time; but after the rendering of the decree had used the volume decreed. It was held that in the first case the decree, not being appealed from within the statutory period, was conclusive as to the rights of the ditch company, but its failure to put the volume of water decreed to it to a beneficial use within a reasonable time constituted an abandonment. In the second case, also, the decree was conclusive, but the water was immediately put to a beneficial use and the ditch had the right to the quantity decreed it, even if it had never used this volume prior to the rendering of the decree.

Under these decisions a decree becomes somewhat analogous to an approved application in Wyoming or Nebraska, with this difference: The approved application states the time within which the

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[a] "The diversion ripens into a valid appropriation only when the water is utilized by the consumer." (Platte Water Company *v.* Northern Colorado Irrigation Company, 12 Colo., 531.)

[b] New Mercer Ditch Company *v.* Armstrong, 40 Pac., 989; and Boulder and Weld County Ditch Company *v.* Lower Boulder Ditch Company, 43 Pac., 540.

water must be put to a beneficial use, and the law provides for the submission of proof of the use of the water, while under the decree there is no such provision, but the burden of proof is on the adverse claimant, who must show abandonment. The Colorado adjudications look like an abandonment of the principle of beneficial use, but a more correct view of them is that they recognize the principle and go upon the theory that the construction of a ditch creates a presumption that the volume of water which it will carry has been put to a beneficial use.

This interpretation of the principle of beneficial use greatly simplifies the adjudication of rights and the distribution of water, but has been the cause of more trouble than any other one feature of the Colorado water law. Most of the adjudications of rights to the South Platte and its tributaries took place soon after 1880, and about the time that many of the large canals were constructed. Few, if any of them, were using their full capacities and no great care was exercised in determining ditch capacities, most of the decrees being based on estimates. (See pp. 26–36.) In this way it happened that most ditches were decreed larger volumes of water than they were using and many of them more than they could carry. The sum of all the rights decreed was for more than the stream supplied, but since few took or attempted to take all they were decreed, there was enough to satisfy most of the demands. As the lands under these ditches were brought under cultivation there was an increased use of water all along the line, until there was shortage. Then the injustice of the decrees began to be felt. The use of water by newcomers under the canals having the earlier rights took water away from those who had been using water perhaps for years from canals having later rights. The expansion was not limited to using larger volumes but the time of use was extended. Ditches which served small areas and diverted water only part of the time were made to serve more land and diverted water continuously during the irrigating season; land which was used for crops which required water only during the time when the streams are high were planted to crops which required water late in the season when the streams are low. All of these enlargements were at the expense of the holders of the later rights, and if the early rights had been limited to the quantity beneficially used at the time the later rights were acquired the enlargements could not have been made. As a rule, the increased use was well within the decreed rights of the earlier ditches, but this did not lessen the hardship on the holders of the later rights.

The same expansion in use is not possible under the Wyoming and Nebraska systems properly enforced. Irrigators are granted rights to sufficient water for certain areas, rather than fixed volumes. The

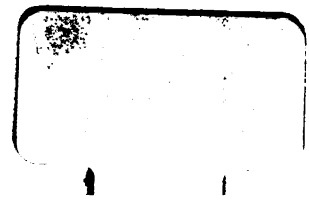
volume used on a farm may increase with a change in the nature of the crops raised, as in Colorado, but this increase is small when compared with that which takes place when both the area and the use increase. It is, however, just as truly a departure from the principle of beneficial use and the hardship to the holder of the later rights is less in degree only.

It is in connection with this increased use that transfers of water rights have been most objectionable. In many cases ditch owners who received decrees for more than they had used or needed to use, or more than their ditches could carry, sold the surplus to which, under the principle of beneficial use, they had no right. They continued to use as much as ever, while whatever was used by the purchasers of their surplus rights was taken from the holders of later rights. However, this can not be charged against transfers, as such, since if the rights had never been recognized they could not be transferred.

As to the effect of differences in the nature of the water-right systems of the three States on the just division of the water of the Platte River between the States, the preceding pages show that physical conditions are such that there will be little occasion for controversy as to the division of the water of the North Platte between Colorado and Wyoming and that water rights in Wyoming and Nebraska are based on similar laws. The nature of the rights will not therefore affect the just distribution of the water of the North Platte between Wyoming and Nebraska. Although in general rights in Colorado and Wyoming differ in their nature, the Colorado decrees defining rights to water from Laramie River are exceptions to the rule and base rights on the needs of given areas of land, making them similar to rights to water from the same stream in Wyoming.

The rights to water from the South Platte in Colorado are to definite volumes of water based very largely on liberal estimates of ditch capacities rather than on the volumes of water which had been used at the time the rights were adjudicated. Rights in Nebraska entitle their holders to sufficient water for given areas with the limit of 1 cubic foot per second to 70 acres. It is pointed out in the enumeration of the rights to water from the South Platte that in both Colorado and Nebraska rights very largely in excess of what had been used or the stream supplied at the time the rights were adjudicated have been recognized. Since these rights in Colorado are for definite quantities of water, as time goes on the tendency will be for the use to increase up to the full volumes decreed, and for this water to be spread over larger areas as economy in use takes place. On the other hand, rights in Nebraska being based on the need of particular pieces of land, the volumes used will be limited to those needs, which will tend to diminish as the time that the land has been irrigated

lengthens. The nature of her water rights, therefore, gives Colorado a theoretical advantage in the distribution of the South Platte. As shown by the tables of stream flow and of rights, the rights in Colorado prior to any in Nebraska exhaust the stream, and practically all the water which goes to Nebraska is local drainage and return seepage which can not be diverted in Colorado, and therefore the theoretical advantage has little to do with the division of the water.

CONCLUSION.

The foregoing report seems to justify the conclusion that under existing physical conditions and in view of the dates of the acquirement of existing rights the enforcement of rights as based on the laws of the three States will do no substantial injustice to the irrigators in any one of the States. As between the States therefore, the whole question resolves itself into a matter of distributing the water of these streams to existing rights regardless of State lines. This can be accomplished by agreements between the States, but if it is not done in that way justice will demand that the Federal Government provide for this distribution.